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FIRST ANNUAL REPORT

OF THE

Quebec Society for the Protection of Plants from Insects and Fungous Diseases

1908-1909

MONTREAL:
THE HERALD PUBLISHING COMPANY
1909

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FIRST ANNUAL REPORT
of the
QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS
from
INSECTS AND FUNGOUS DISEASES.

1908-1909

To the Honourable JEREMIE DECARIE, K.C., M.P.P.,
Minister of Agriculture.

Sir:—

I have the honour to present herewith the First Annual Report of the Quebec Society for the Protection of Plants from Insects and Fungous Diseases, containing the proceedings of the Summer and Winter meetings of the Society which were held at the Macdonald College, Ste. Anne de Bellevue, Que., on the 24th of June, 1908, and the 16th day of March, 1909, respectively.

Account is given of the papers that were read and the reports of the various officers of the Society.

I have the honour to be, Sir,

Your obedient servant,

DOUGLAS WEIR,
Secretary-Treasurer.

Macdonald College, Que.,
1909.

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS.

OFFICERS FOR 1909-1910.

President—William Lochhead, B.A., M.Sc., Professor of Biology, Macdonald College, Que.

Vice-President—Mr. Auguste Dupuis, Director of Experimental Fruit Stations, Village des Aulnaies, Que.

Secretary-Treasurer—Douglas Weir, B. S. A., Assistant in Biology, Macdonald College, Que.

Curator and Librarian—J. M. Swaine, M. Sc. A., Lecturer in Zoology and Entomology, Macdonald College, Que.

Directors—Rev. Dr. Thos. Fyles, Hull, Que.; Rev. Brother Liguori, La Trappe, Que.; Rev. Geo. Ducharme, Rigaud, Que.; A. F. Winn, Esq., Montreal, Que.; Dr. Grignon, St. Adele, Que.

Auditors—Norman Jack, Esq., Chateauguay Basin, Que.; Professor G. Dimitrion, Agricultural Institute, La Trappe.

MEMBERS OF THE QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS.

Arkell, Prof. H. S.	Macdonald College.
Brittain, Dr. John	" "
Blair, Prof. Saxby	" "
Bates, F.	" "
Barton, H.	" "
Campbell, Rev. Dr. Robt.	Montreal.
Chagnon, Geo.	"
Chapais, J. C.	St. Denis-en-bas, Que.
Dimitrion, G.	La Trappe, Que.
Ducharme, Rev. Geo.	Rigaud, Que.
Dupuis, Auguste	Village des Aulnaies, Que.
Dalaire, O. E.	St. Hyacinthe, Que.
Dasen, H.	Macdonald College.
Edouard, Rev. Brother	La Trappe.
Elford, Fred. C.	Macdonald College.
Fyles, Rev. Dr. Thos. W.	Hull, Que.
Grignon, Dr. W.	St. Adele, Que.
Gardner, Prof. V. R.	University of Maine, U.S.A.
Harrison, Dr. F. C.	Macdonald College.
Huard, Rev. Abbe	Laval University, Quebec City.
Jack, Norman E.	Chateauguay Basin, Que.
Klinck, Prof. L. S.	Macdonald College.
Liguori, Rev. Brother	La Trappe, Que.
Lyman, Henry H.	Montreal.
Lochhead, Prof. Wm.	Macdonald College.
Moore, G. A.	Montreal.
Nantel, G. A.	Montreal.
Nagant, H.	Quebec City.
Newman, C. P.	Lachine Locks, Que.
Reid, Peter	Chateauguay Basin, Que.
Swaine, J. M.	Macdonald College.
Tourchot, A. L.	St. Hyacinthe, Que.
Vanderleck, J.	Macdonald College.
Winn, A. F.	Montreal.
Weir, Douglas	Macdonald College.

Honorary Member:

James W. Robertson, Esq., L.L.D., C.M.G.

FINANCIAL STATEMENT.

OF THE

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS, FROM INSECTS AND FUNGOUS DISEASES.

1909.

RECEIPTS.

Provincial Government cheque for 1908	$ 250.00
Interest on deposit, Bank of Montreal	5.04
	$ 255.04

DISBURSEMENTS.

Members expenses to Summer and Winter meetings	$ 30.35
Stationery and Printing	26.50
Delegates to Quebec, re printing of Annual Report	27.85
Postage and Express	2.80
Investigation of Insect and Fungous diseases	20.00
	$ 107.40
Balance, cash on hand April 20th, 1909	147.64
	$ 255.04

DOUGLAS WEIR, Sec.-Treas.

WILLIAM LOCHHEAD, President.

Auditors:

NORMAN JACK.
G. DIMITRION

FIRST ANNUAL REPORT

OF THE

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS.

INAUGURAL MEETING.

The Need for a Society of this Kind.

The yearly loss to the cultivated crops of Quebec from the attacks of insects and fungous diseases runs up into the millions. The rapid increase in numbers of injurious insects and fungi in recent years has been generally recognized. Any person who attempts to grow plants, whether in greenhouse, garden or orchard, soon becomes convinced of the fact that he must wage unceasing warfare against the enemies of the plants, if he expects to grow a fair crop to maturity. It is not difficult to find an explanation for this condition of affairs. Ready transportation facilities permit of ready exchange of products between the various countries of the world. Plants are introduced from foreign countries and very frequently their insect and fungus enemies are brought with them. Besides, man has disturbed very much the balance that exists in the state of nature between plants and animals. He clears the forest and cultivates large areas of plants of the same kind. In so doing he provides abundant food supply for those insects and fungi that prey specially upon that kind of plant. As a result, these pests increase enormously in numbers in a short time.

Again, the wanton destruction of birds by our so-called sportsmen has materially increased the number of injurious insects, for it is a well known fact that the great majority of our common birds feed largely upon insects.

It will be observed, therefore, that while many of our insect and fungus enemies are native to this country, and fed originally altogether on the wild forms of our cultivated plants, a fairly large number are of foreign origin and were introduced along with the plants upon which they were feeding.

As our modern civilization is largely built upon agriculture, the culture of the soil for the production of crops, and the tendency is towards a more intensive system of cultivation, the greater will be the danger of insect and fungus multiplication.

Many states and provinces have already recognized this danger and have given aid to societies for the special study of insect and fungus pests. The Ontario Entomological Society for example has been in active existence for about 45 years, and has done much to impress upon the people of that province its importance as a factor in the welfare of the province.

Quebec, however, has lagged a little behind her sister province in this matter. While a few individuals paid some attention to the study of insects and fungi, there was no official Society in the province to which the people could look for help, and which could bring together the scattered labors of the workers in those fields of investigation.

Organization.

It occurred, therefore, to a few persons who were specially interested in the economic phases of insect and fungus life that an effort should be made to organize a Society of this nature for the Province of Quebec. Assurances of help and co-operation were given by the Department of Agriculture of Quebec and by the members of the Council of Agriculture when they were approached and the objects of the new Society were explained. Accordingly on June 18th, 1908, the following letter was sent to all persons who were known to be engaged in the study of insects or fungi, more especially with reference to their economic relationships, calling a meeting at Macdonald College for June 24th for the purpose of organization.

Macdonald College, June 18th, 1908.

Dear Sir:—

As you are well aware, the damage done every year by insect pests and parasite fungi to the various crops of the farm, orchard, and garden is very great, and in some cases, somewhat alarming. While there are a few societies for the systematic study of insects, there are none for the study—from an economic standpoint—of those forms of life that are of economic importance, and that produce plant disease.

At the request of several persons interested in the economic study of fungous diseases and insects—in their relation to agricultural and horticultural crops of all kinds—the Minister of Agriculture, on the advice of the Council of Agriculture, has been pleased to give a small grant for the purpose of aiding the formation of a "Society for the Protection of Plant Diseases." I believe you are interested in such a cause, and would be willing to become an active member of such a Society. You are cordially invited to be present at the meeting for organization at Macdonald College, Ste. Anne de Bellevue, on Wednesday, June 24th, at 2 p.m., in the Biology Building. I may say that your out-of-pocket expenses will be paid.

The Minister of Agriculture and the Council, are of the opinion that there is a sufficiently large number of persons—both French and English—in the Province of Quebec, acquainted with the common diseases of plants, to make a flourishing Society, and to do a work that will be of value to the Province.

Hoping that you can arrange to be present at the meeting, I am,

Yours very truly,

W. LOCHHEAD,
Prof. of Biology.

The following persons were present at the meeting: Rev. Dr. Fyles, Levis; Rev. G. Ducharme, Rigaud; Rev. Brother Liguori, La Trappe; Peter Reid and Norman Jack, Chateauguay Basin; Rev. Dr. Campbell, Montreal; A. F. Winn, Montreal; Dr. W. Grignon, Ste. Adele; Dr. J. W. Robertson, Prof. F. C. Harrison, Dr. J. L. Todd, Prof. W. S. Blair, J. M. Swaine, Douglas Weir, and Prof. W. Lochhead of Macdonald College.

The following officers were elected:

President—Prof. W. Lochhead.

Vice-President—Rev. Brother Liguori.

Secretary-Treasurer—Douglas Weir.

Directors—Rev. Dr. Fyles,

Rev. G. Ducharme,

Auguste Dupuis,

A. F. Winn,

Dr. W. Grignon.

Curator-Librarian—J. M. Swaine.

The Society adopted the following Constitution:

CONSTITUTION AND BY-LAWS

OF THE

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS FROM EITHER INSECTS OR FUNGOUS PESTS.

Section 1.—Objects and Membership.

Article 1.—The Society shall be called "The Quebec Society for the Protection of Plants," and is instituted for the investigation of the character and habits of economic insects and fungi.

Article 2.—The headquarters of the Society shall be at Macdonald College, Ste. Anne de Bellevue, Que.

Article 3.—The Society shall consist of four classes of members, viz., Ordinary, Life, Corresponding and Honorary.

Article 4.—Ordinary Members shall be persons who are interested in insects and fungi, or whose pursuits are connected with some phase of biology.

Article 5.—Life Members shall be persons who have made donations to the value of $50 in money, books, or specimens (the two latter to be valued by competent persons), or who may be elected as such at the General Meeting of the Society, for important services performed, and after due notice has been given.

Article 6.—Corresponding Members shall be persons residing out of the Dominion of Canada, whose pursuits are similar to the Ordinary Members.

Article 7.—Honorary Members shall be persons of high standing and eminence for their attainments in biology.

Article 8.—The Officers of the Society shall consist of a President, a Vice-President, a Secretary-Treasurer, a Curator and Librarian, and five Directors to form a Council; all of whom shall be elected annually at the Annual General Meeting of the Society, and shall be eligible for reelection.

Section II.—Officers.

Article 9.—The duties of the President shall be to preside at all meetings of the Society, to preserve good order and decorum, to regulate debates, and to have general direction of the Society in the interval between Annual Meetings.

Article 10.—The duties of the Vice-President shall be the same as those of the President, during his absence.

Article 11.—The duties of the Secretary-Treasurer shall be to take and preserve correct minutes of the proceedings of the Society, to present and read all communications addressed to the Society, to notify members of their election, to keep a correct list of members of the Society and their addresses, with the dates of their election, resignation, or death, and to maintain the correspondence of the Society and to acknowledge all donations to it. He shall also take charge of the funds of the Society, and keep an accurate account of all receipts and disbursements, and of the indebtedness of members, and render an annual report of the same at the Annual General Meeting of the Society.

Article 12.—It shall be the duty of the Curator and Librarian to take charge of all books, specimens, cabinets, and other properties of the Society, to receive and arrange in their proper places all donations of specimens; to keep a record of all contributions of books or specimens, with a list of the contributors; and to oversee and direct any exchange of specimens. He shall also report annually to the Society on the condition of the specimens and cabinets under his care.

Article 13.—The Officers of the Society, together with five Directors, elected annually, shall form a Council who shall have the direction and management of the affairs of the Society.

Article 14.—The Council shall draw up a Yearly Report on the state of the Society, in which shall be given an abstract of all the proceedings, and of the receipts and expenditure of the Society during their term of office, and of such information as the Society may have been able to obtain on the subject of plant diseases and insects beneficial or injurious to the farm and the garden, etc., which shall be sent to the Minister of Agriculture within 30 days after the holding of the Annual Meeting.

Section III.—Meetings.

Article 15.—The Annual General Meeting of the Society shall be held in the winter months of each year, on a day to be selected by the Council, to receive and deliberate upon the report of the Council on the state of the Society, to elect officers and members of the Council for the ensuing year, and to transact any other business of which notice has been given.

Article 16.—The Summer Excursion of the Society, for the purpose of studying any unusual outbreaks of disease or insect pests and for collecting, shall be held during the month of August; the day and place of meeting to be decided upon by the Council.

Article 17.—Special Meetings of the Society may be called by the President upon the written request of five members of the Society, provided that one week's notice of the meeting be given, and that its object be specified.

Section IV.—Branches of the Society.

Article 18.—Branches of the Society may be formed in any place within the Province of Quebec, on a written application to the Society, from at least six persons resident in the locality.

Article 19.—Every Branch shall be governed by the Constitution of the Society, but shall have power to elect its own officers, and enact bylaws for itself, provided they be not contrary to the tenor and spirit of the Constitution of the whole Society.

Article 20.—All the members of the Branches shall be members of the Society, and entitled to all the privileges of ordinary members.

Article 21.—No Corresponding or Honorary Member shall be appointed by the Branches, but such members may be proposed at General Meetings of the Society by any Branch, as well as by individual members.

Article 22.—Each Branch shall transmit to the Parent Society an Annual Report of its proceedings, such report to be read at the Annual General Meeting.

Section VII.—Alteration of Constitution.

Article 23.—No article in any Section of this Constitution shall be altered or added to, unless notice be first given at an ordinary meeting of the Society, or of a Branch, and the alteration or addition be sanctioned by two-thirds of the members present at the next ensuing meeting.

Ratified by the Society at Macdonald College, June 24, 1908.

Letters were received from Rev. Abbe Huard, Quebec; the late Dr. Jas. Fletcher, Ottawa; H. H. Lyman, Montreal; G. Chagnon, Montreal; J. C. Chapais, St. Denis; Auguste Dupuis, Village des Aulnaies; A. L. Tourchot, and Mr. Delaire of St. Hyacinthe, expressing their approval of the formation of the Society, and their regrets that they could not attend through pressure of other duties.

REPORT OF WINTER MEETING.

The First Winter Meeting of the Quebec Society for the Protection of Plants from Insects and Fungous Diseases, was held in the Biology Building of Macdonald College, Ste. Anne de Bellevue, Que., on Wednesday, March 10th, 1909.

The meeting was called to order at 2.30 p.m., the President, Professor Lochhead, of Macdonald College, occupying the chair. There were present:—Messrs. J. C. Chapais, St. Denis; Rev. Brother Liguori, La Trappe; Dr. Thos. Fyles, Levis; Norman Jack, Chateauguay Basin; F. Winn, Montreal; G. Dimitrion, Oka; Prof. H. S. Arkell, Macdonald College; J. M. Swaine and Douglas Weir.

The minutes of the last meeting were then read and approved. The Treasurer was then called upon for his report which, after being audited by Messrs. Jack and Dimitrion, was found accurate and approved.

The subject of the Society's annual report then came up for discussion and after some consideration it was proposed by Mr. Chapais and seconded by Dr. Fyles, " that a Committee, to be composed of Prof. Lochhead and Brother Liguori, correspond with the executive committee of the Quebec Pomological Society as to their pleasure regarding the combining of the two Societies' reports in one volume and that if such meet with approval, the above mentioned gentlemen be authorized to wait upon the government at Quebec, along with the Executive of the Pomological Society, in connection with this matter; and further,—that in addition to the double report a number of single copies be struck off for the individual uses of the respective societies.—Carried."

The election of officers for the ensuing year resulted as follows:—

President—Prof. Wm. Lochhead, Macdonald College.

Vice-Pres.—Auguste Dupuis, Village des Aulnaies.

Sec.-Treas.—Douglas Weir, Macdonald College.

Curator of Museum—J. M. Swaine, Macdonald College.

Board of Directors:—

Rev. Brother Liguori, La Trappe.

Dr. Thos. Fyles, Levis.

G. Ducharme, Rigaud.

A. F. Winn, Esq., Montreal.

Dr. Grignon, Ste. Adele.

Upon motion of Dr. Fyles, seconded by Mr. Chapais, it was resolved "that a committee, composed of the President and the Secretary-Treas. be authorized to grant, when they may deem it advisable, certain monetary considerations to persons willing to carry on investigations for the Society, along the lines of Insect Pests and Fungous Diseases."

Carried.

The business of the meeting being disposed of, the President, Prof. Lochhead, delivered his annual address.

The President, in the course of his opening remarks said:—

Gentlemen:—

"I take great pleasure in welcoming the members and friends of the Quebec Society for the Protection of Plants to this winter meeting and to Macdonald College.

"The object of this Society is given in the first article of its Constitution, which states that it "is instituted for the investigation of the character and habits of economic insects and fungi." But the work of the Society is not limited to pure investigation alone; it must go beyond that and spread the knowledge it has gained by research, among the people. It takes a long time to instil into the minds of the mass of people the fact that a Society such as ours can be of real service to them. Our objects cannot be accomplished in one year, or in ten years. It will require persistent reiteration for many years of the facts that we have to furnish regarding the habits and the methods of controlling and preventing the ravages of insects and fungous diseases, before the majority of the people will voluntarily put into practice the advice which we may offer.

"With regard to the work which the Society has accomplished since its organization in June last, I may say that considerable valuable information of a preliminary character has been secured with reference to the distribution of injurious insects and fungi in the Province. In any serious investigation of insect and fungous troubles, one of the first duties is to ascertain the distribution of the more common forms, whether troublesome or not, by personal collection or otherwise. It is unfortunate that there are so few capable observers and collectors in Quebec; men who have a habit of observing so carefully that their records may be considered worthy of being filed. This scarcity of good observers may be attributed largely to the practical absence of instruction in our Colleges on the economic phases of insect and fungous life. However, with the advent of such Agricultural Colleges as the Institut Agricole at La Trappe and the Macdonald College at Ste. Anne de Bellevue we may hope in a short time to have students in all parts of the province informed on this important branch of study, and able to report accurately what they have observed.

"Furthermore, insects are better known than fungi, a fact largely due, I think, to the influence of the late Dr. Jas. Fletcher of the Central Experimental Farm, Ottawa, who as an Entomologist carried his own contagious enthusiasm for the study of insect life wherever he went through this province. Wherever one may go he will come across the footprints of this grand man who did such fine work in a new field and who aroused new interests among so many of those he met.

"Fortunately, we have in our midst some men who have given much time and thought to the matters in which our Society is vitally interested. We have Rev. Abbé Huard, of Quebec City, the Editor of the well-known Le Naturaliste Canadien; Rev. Dr. Thos. Fyles, of Levis, who is well known through his studies of the Insects of Quebec, Mr. J. C. Chapais, of St. Denis, a man of encyclopaedic knowledge in many branches of Agriculture, and who finds time to make valuable observations on insect and fungous life; Mr. H. H. Lyman of Montreal, who has done much entomological work himself, and who has infused his own spirit in the lives of many younger workers, like Mr. A. F. Winn, G. Chagnon and G. A. Moore. The services these and other Montreal entomologists have done are of great value to the economic worker. Rev. Dr. Campbell of Montreal has for many years been an indefatigible collector and student of fungi, and his intimate knowledge of the fungous flora of the Island of Montreal will also be of great service to our Society.

"Mention should be made here of the men who are connected with the Institut Agricole at La Trappe, and with the Biology and Bacteriology Departments of Macdonald College, and who are specially concerned with the economic aspects of insect and fungous life. To those persons the province naturally turns for special help and advice in the control of plant diseases.

"As a Society, we may very particularly ask ourselves 'what are some of the most pressing problems requiring solution, and to which we ought to devote considerable attention?' Among insect pests the more important are: the codling worm, the bark beetles, the apple maggot, and the plum curculio in the orchards; the cabbage and onion maggots, the squash beetle, and the potato beetle in the gardens; the horn fly in the stables, and the tussock moth on shade trees.

Among the more important fungous pests are the apple scab, the brown rot, and the black rot canker of orchards; the potato blights, and the mildews of many vegetable crops; and the smuts and rusts of cereals.

Each and all of these subjects are worthy of careful investigation, as they cause large loss every year to this province.

" Efforts are being made in Government and other quarters to improve agricultural conditions, so that better products and more of them may be obtained from the farms of this province, but the tendency is to neglect those factors that make for the protection of the products while in process of manufacture. It is surely wise to devise means of protecting our crops after so much time and energy has been spent in preparing the land and selecting the seed. It has been computed that one-tenth of the value of our crops is destroyed annually by insects, and one-tenth by fungous diseases. Placing the value of our farm crops every year at the very conservative estimate of 65 millions, we have therefore the tremendous annual loss to the country of 13 millions of dollars due to insects and fungi."

Prof. Lochhead then outlined many specific instances that had come under his notice, either directly or through members of his department, during the past summer and concluded by calling upon the Canadian public for their co-operation in this national work.

Mr. J. C. Chapais followed, with an address on " Injuries to Plants caused by Eelworms " (Anguillula heterodera). The speaker remarked, that it was only recently that this subject had occupied his attention. Owing to the fact that there had been a wholesale destruction of his green-house plants, he was forced to undertake the investigation of the subject in order to, if possible, prevent further loss.

Mr. Chapais' observations were in brief, that the early growth of the affected plants appeared normal. When, however, they began to spread their foliage, thickened and discoloured areas appeared on the leaves and subsequently spread very rapidly. This was particularly evident in the case of certain Ivy-Geraniums which he (Mr. Chapais) had been growing and which were eventually killed. The speaker was of the opinion that many garden and hot-house plants are similarly affected without the real cause being known. Further, that although the disease can scarcely be said to be epidemic, it is nevertheless an injury to be dreaded once it has gained an entrance to the plant as no subsequent spraying will avail for the obvious reason that the parasite lives within the tissues of the leaf and quite out of reach of the ordinary spray.

In concluding, Mr. Chapais recommended that all diseased leaves be burned, and potted plants be soaked in Soda-Carbolic solution. (See article on " Geranium Disease " in this report).

Other addresses included:—" Insects attacking Indian Corn," by Rev. Dr. Thos. Fyles; " Economic Insects of Montreal Island," by Mr. F. Winn, Montreal; " Insects of the Season 1908," Mr. J. M. Swaine.

INJURIOUS INSECTS OF THE MONTREAL REGION IN 1908.

J. M. Swaine, Macdonald College.

During the past season insects have been less injurious to crops in this part of Quebec than usual. Certain common enemies were present of course and were responsible for considerable loss.

The Codling-moth has been everywhere present, and damage to unsprayed trees serious. If orchardists would appreciate the importance of spraying with Paris Green or Lead Arsenate immediately after the blossoms fall, serious loss from this cause would not be met with. In the Montreal district but one brood per season occurs. Throughout parts of the Eastern Townships a partial second brood is found. So far we have no evidence of a complete second brood in this province.

The Railroad Worm is still injurious in scattered localities, probably spread by infested fruit. At Como and in the Covey Hill district considerable loss was noticed. This maggot is a very serious pest, and its appearance should result in every effort being made for its extermination. Collection and destruction of all fallen fruit is the only method of control.

The Plum Curculio does more damage in Quebec to apples than to plums. As a rule this beetle prefers to attack plums, if they are available, but feeds upon the apple readily. In apples this is a very difficult insect to control; jarring is largely impracticable and recourse must be had to poisoned sprays and immediate destruction of fallen fruit.

The Round-headed and Flat-headed Borers were met with at various places. They doubtless occur throughout the province. Careful attention to their destruction and control will be repaid.

The Bud-worm, the Case-bearers and the Canker Worms were not noticed in serious outbreaks.

The Apple-tree Tent Caterpillars are apparently at a low ebb just now in this region, doubtless owing to the work of their parasites.

The Apple Aphis caused considerable damage in many places. Kerosene emulsion thoroughly sprayed in the late spring, as the eggs are hatching, will prevent much of the injury. As a rule, on large trees their parasites obtain control of the plant lice before much injury is done. On small trees, however, the damage is often serious. Young orchards should be watched and if the plant lice become very numerous and the leaves are beginning to curl, a thorough spraying with kerosene emulsion or tobacco decoction should be given at once. (Fig. 1). After the leaves are curled it is difficult to reach the insects. With small trees the tips of the branches, which are the parts most affected, may be dipped in a pail of the insecticide.

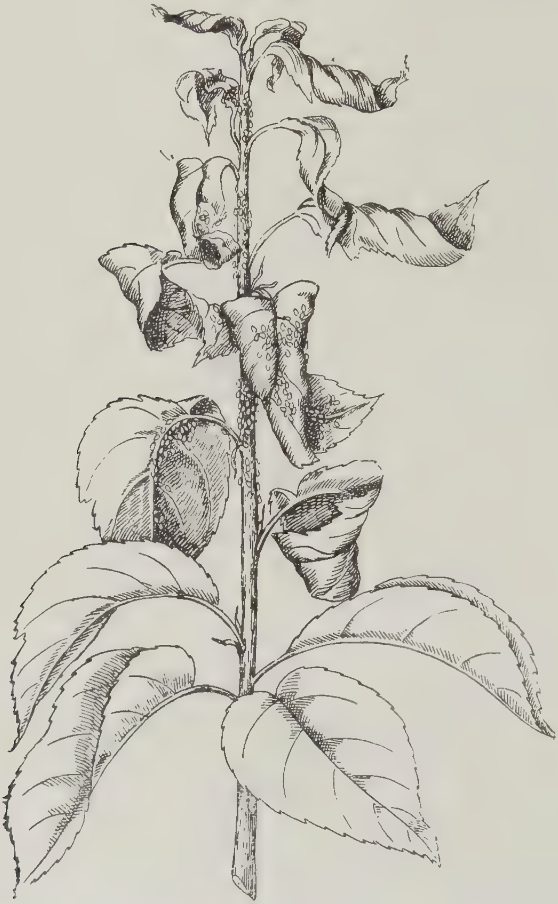


FIG. 1—Terminal shoot of apple infested with the apple aphis showing condition of leaves. (After Quaintance.)

Few serious outbreaks on small fruits were noticed. Much damage was done to raspberries by the Leaf Mites. These mites were extremely numerous, affecting a great variety of plants. They are very small, yellowish or brown in colour, and live mainly on the under sides of the leaves. They spin a slight web, which is quite effective in warding off sprays. The mites feed by piercing the skin of the leaf and sucking up the juice; the leaves become considerably distorted and finally turn brown.

Experiments were begun at the Macdonald College to determine the value of summer spraying for these pests. Nico-soap, whale-oil soap and tobacco decoction gave fair results. Better results were obtained from V2 and kerosene emulsion. Water in a strong spray was at least as effective as the first three named. Lime-sulphur was very effective in killing the mites, but of course also killed the leaves. It will be tried however as a winter spray. Later the whole patch, excepting check-rows, was sprayed with V2, tobacco decoction, whale-oil soap, and kerosene emulsion. Wherever the spray was carefully applied, the under sides of all the leaves soaked, very nearly all the mites were killed; but owing to the distortion of the leaves, and to the web with which they were covered below, thorough spraying required much time and care. The expense was therefore heavy compared with the benefit obtained. Probably the mites can be better controlled by winter spraying. Experiments will be carried on along this line before the season opens. Mites on garden foliage can be killed by any of the four sprays last named if the application is thorough. It is necessary to soak the under side of every leaf.

The Raspberry Cane Borer and the Currant Worm were fairly common nearly everywhere. Cutting the affected canes as soon as the trouble is noticed in the case of the former, and applying hellebore or other stomach poison in the case of the latter, are the best methods of control.

The Colorado Potato Beetle was a most serious pest in this region during the past season. Although the air was warm enough to bring the beetles out early, the ground was too wet for working until late; with the result that by the time the young potato plants appeared the adult beetles had all emerged from their winter quarters, and were waiting on the rows. For a time it seemed impossible to check their ravages; the potato plants were eaten back as fast as they appeared above the ground. With so little surface on the plants for its application Paris Green seemed of little use. It is certainly better under such conditions to apply the spray to each plant individually. When the beetles are very numerous in the early season I believe it is cheaper, and it is certainly more effective, to hand pick them until the plants get a fair start, after which poison sprays can be depended upon. The small yellowish eggs for the second brood are laid by the early appearing females upon the leaves of the small potato plants or on weeds or grass between the rows, and are readily seen and easily destroyed. If it could be done at small expense, by boys, it would pay to have these first eggs hand-picked and destroyed.

Experiments are being undertaken at this College to determine what proportion of poison and what methods of spraying will give the best results. Many potato growers assume that careless spraying with a large proportion of poison is cheaper in the end, owing to the time saved, than thorough spraying with a weaker solution. One pound of Paris Green to 50 gallons of water will kill the beetles and grubs if the spraying is properly done.

Cabbage Maggots in cabbages and Onion Maggots have not yet appeared on the Macdonald College farm. The cabbage maggot is however very injurious in many places in this region, and was common here in radishes. The reports from various Experiment Stations as to the value of tarred-paper discs in protecting from cabbage maggots are conflicting. Some recommend the discs unreservedly; others report severe injury to the plants from their use. All reports seem to agree, however, that tarred-felt discs protect from the maggot and do not injure the plant.

Cabbages suffered from various cut-worms. Some of these cut the plants off at the surface of the ground. These are best controlled by scattering poisoned bran about the bases of the plants. Other species climb upon the plants during the night and feed upon the leaves. These may be killed readily by spraying the plants with lead arsenate. The worms hide during the day in the earth beneath the plants and may be hand-picked.

The Cabbage Aphis and the common green cabbage worm were everywhere abundant. The latter is always easily controlled by Paris Green or Pyrethrum Powder. The former may be destroyed by Kerosene Emulsion. As a rule it does most injury to turnips late in the season. Remains of these crops should be destroyed in the fall. (Fig. 2).

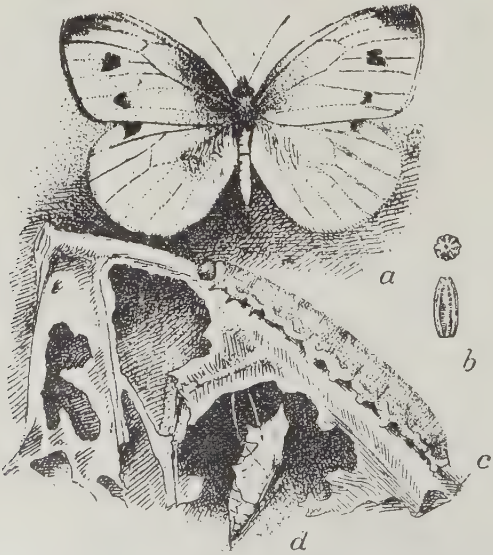


FIG. 2—Pontia rapœ: a, female butterfly; b, above, egg as seen from above; below, egg as seen from side; c, larva in natural position on cabbage leaf; d, suspended chrysalis—a, c, d, slighly enlarged; b, more enlarged. (From Chittenden.)

The Carrot Rust Fly has not been met with in this region, but was reported as doing serious injury in the eastern part of the province. The carrots should be sprayed with Kerosene Emulsion once a week through June and July, beginning with the first thinning.

The Squash Bug is rarely met with here, but the Cucumber Beetle is a most serious enemy to squashes, cucumbers and melons. (Fig. 3).

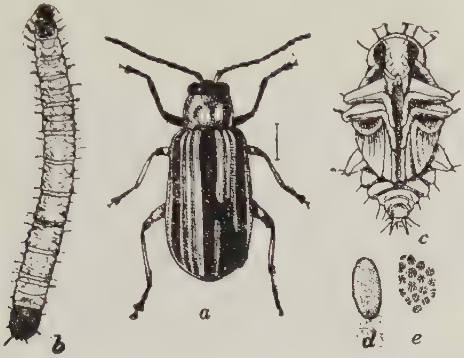


FIG. 3—Diabrotica vittata: a, beetle; b, larva; c, pupa; d, egg; e, sculpture of same—a, b, c, much enlarged; d, more enlarged; e, highly magnified. (After Chittenden.)

Poison seems often to have little effect upon it. Perhaps the best remedy is poisoned Bordeaux applied as often as needed. Paris Green or Pyrethrum Powder mixed with land plaster, flour or any fine powder, and dusted on the plants while they are wet will keep the beetles away for a time. The young plants should be protected by cheese cloth until the first brood of beetles has disappeared.

Apple Leaf Hoppers did an immense amount of damage last season to various crops. Potatoes, peas and beans perhaps suffered most severely in this district. The young do not fly and may be destroyed by Kerosene Emulsion. After they become adult they fly readily and become almost beyond control.

The Hickory Tiger Moth has been unusually abundant the past two seasons, the caterpillars stripping the leaves from large branches of many of our most valuable shade trees. Removing the cluster of caterpillars while they are small, and before they spread over the tree, or spraying with Paris Green will prevent serious injury.

The Fall Web Worm has also been more than usually common. (Fig. 4). Its unsightly webs disfigure many branches of our finest shade trees every year. The webs should be cut away when small and the caterpillars destroyed. The webs and the caterpillars may be burnt with a torch.

The White-marked Tussock Moth during the season of 1907 was remarkably numerous about Montreal; its caterpillars were abundant on

Work of Fall Web Worm.
(From Washburn.)

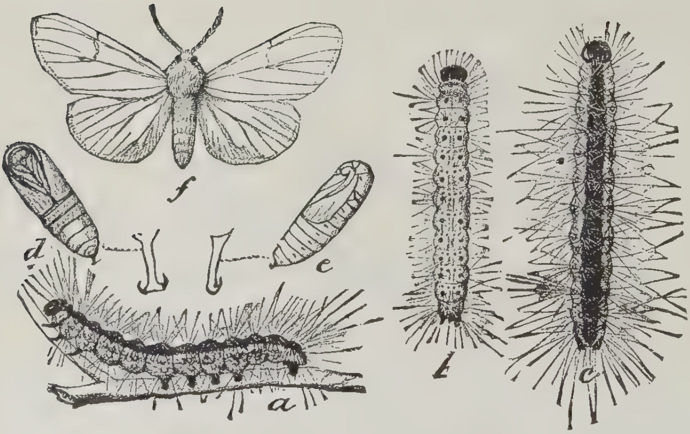
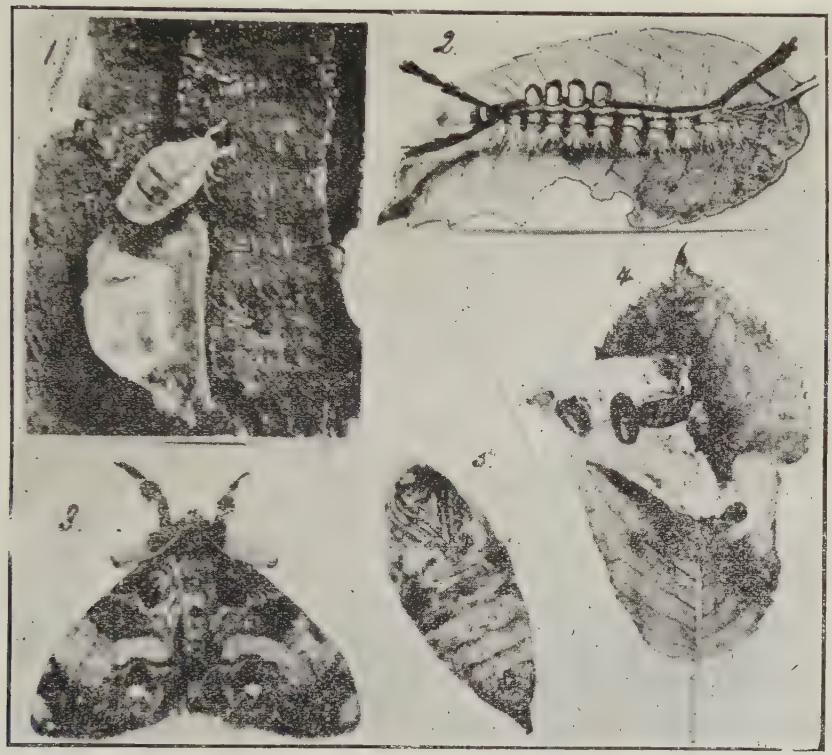


FIG. 4—The Fall Web Worm: a, dark covered larva from the side; c, the same from above; b, light covered larva; d. pupa from below; e, same from side. Bureau of Entomology, U.S. Dept. Agrl.

the city's finest shade trees, and apparently threatened them with destruction. As is usually the case with this species, however, its parasites obtained control of it in time. During the season of 1907 Mr. Weir and I collected several hundreds of the cocoons and many larvæ. Over 90 per cent. of these were parasitised. Sixteen species of primary parasites were obtained. Allowing for egg parasites certainly not over 5 per cent. of the larvæ of 1907 lived to appear as moths in 1908. As a natural result the species was not at all injurious during the past season. When it is necessary to combat them, hand-picking the white egg masses during late fall and winter, and banding the trees in the spring insures freedom from the pests. The egg masses should not be destroyed, but preserved over winter in a receptacle, tightly covered with fine gauze and kept in a cool place. This will allow the useful parasites to escape. (Fig. 5).



THE WHITE MARKED TUSSOCK MOTH, Hemerocampa leucostigma, Sm. and Abb.

FIG. 5—1, Female and egg-mass on cocoon ; 2, larva ; 3, adult male ; 4, parasitised cocoon ; 5, female pupa. 1, 3, 4 and 5, from Schoene ; 2, from Riley.

Ambrosia beetles have been very numerous. In many bushes throughout this region as soon as a maple, yellow birch or beech begins to die, various Ambrosia beetles attack it, driving their black tunnels deep into the wood. This work detracts greatly from the value of such trees for timber. Pterocyclon mali, P. fasciatum, Trypodendron lineatus, T. bivattatus, Xyleborus dispar, and an undescribed species of Xyleborus have been the most numerous.

DISEASES OF PLANTS.

William Lochhead, Macdonald College.

Diseases of plants, for convenience of consideration may be grouped as follows: first, those caused by (a) insects and other animals; (b) fungi; (c) bacteria; (d) slime moulds; and (e) flowering plants, and second, those caused by the unfavorable action of soil, drought, heat, wind, frost and sun scald. Sometimes two or more of these causes may operate to bring about a diseased condition of the plant. In particular, it may be noted that plants which have been rendered unhealthy by excessive moisture, excessive dryness, or imperfect access of light and air, are most liable to attack from insects and fungi. It is not always easy to tell when a plant is in a diseased condition, for the condition of a healthy plant varies between fixed limits, and it is only when these limits are exceeded in either direction that the life of the plant is threatened, and there is disease instead of health. Young plants are, as a rule, more liable to attack by fungi and insects than older plants, because their tissues are softer and their cuticle thinner.

Characteristics of Fungi:—

Fungi are plants just as truly as corn and sunflowers are, but they are more simple and less highly organized. They have neither roots, stem nor leaves, but they are plants nevertheless. They have no chlorophyll or leaf-green as most of our common plants have, and consequently they cannot make food for themselves out of the raw inorganic materials. They are dependent, therefore, upon other plants for their food supply. Some fungi, such as rusts and mildews, are able to get their food from living plants, and are real **parasites,** while others, like mushrooms, get their food entirely from dead plants and are **saprophytes.** Some, like the Brown Rot and Apple Scab, are able to live for a time on living plants, and at another stage on dead plants.

Fungi have no system of vessels for the conduction of food such as we find in the higher plants, but they are composed either of a few threads of living cells, or a mass of threads. Further, fungi do not produce seeds such as are found in the higher plants, but instead, produce **spores,** from which the new plants are developed. Structurally a fungus possesses a **nutritive** part and a **reproductive** part; the former concerning itself with gathering nourishment from the host, and the latter with the production of spores. There is as great variation among fungi as to the forms of the different kinds as there is among the higher plants. Some are extremely simple in structure, while others are quite complex. Again, some fungi live on the surface of their host, while others live within the host.

There are many kinds of spores. Some are thin-walled and germinate almost immediately after they are set free. These are the summer **spores** which spread the disease during the growing period of the host. Others are thick-walled or are enclosed in sacs and are able to resist the frosts of winter. These are the winter spores which carry the fungus over from one season to another, and usually require a period of rest before germination.

Many fungi form both summer and winter spores, and as these are usually quite unlike in appearance and in habit, botanists have frequently described different stages of the same fungus as distinct species. Such mistakes have occurred with Apple Scab, Brown Rot, Bitter Rot and several others.

A fungus gains entrance to its host through the germination of spores carried to the host, and by the growth of germ-tubes. As spores germinate only in the presence of moisture it is to be expected that moist weather with little sunshine is conducive to fungous infection and growth. Sometimes the germ-tube enters the leaf through a breathing pore or stomate; sometimes it secretes an enzyme which dissolves the cell wall and thus effects an entrance; and sometimes the spore alights on an open wound, or in a crack, and thus finds an easy entrance. Once inside the plant, the germ-tube grows rapidly and forms a network of threads, called the **mycelium,** which feed upon the cell juices. As a result, the normal functions of the cells and tissues of the affected plant are disturbed, so that sooner or later a diseased condition is set up, followed either by the death of the cells or by abnormal swellings or distortions of the affected area.

Control of Fungi:—

From a study of the habits of parasitic fungi, we are able to indicate the best lines of treatment. These may all be included in the term **prevention.** A few of these preventive measures will be mentioned here: (1) The application of fungicides which either kill the spores adhering to the plant or prevent them from germinating. To be effective, the fungicide must be applied in a **thorough** manner and at the **proper** time. As a rule early spraying should be done to prevent germination of winter spores which are blown to the stems and leaves in early spring. Late spraying must also be applied to kill the summer spores which have germinated in spite of the treatment. The best general fungicide is Bordeaux Mixture, the preparation of which is well known.

(2) **Pruning** is very effective in controlling such diseases as Black Knot, Apple Tree Canker, and Pear Blight, if all of the diseased wood is removed and burned.

(3) **Good clean seed,** free from spores or disease is essential to the production of healthy plants. Smut in oats, wheat and barley and scab in potatoes can be prevented by attention to this point.

(4) **Cleanliness** about the garden, orchard and farm in the matter of burning the fallen leaves and the destruction of diseased fruit is a very important factor in controlling disease, when we remember that many of the spores winter over in the fallen leaves and fruit.

Some Abnormal Growths and their Causes:—

(1) **Corky growths** as in scab of potato, characterized by the development of large amounts of cork. Causes not clear, but may be fungi, bacteria, absence of lime, or dampness of soil.

(2) **Cankers,** characterized by open wounds in spite of attempts at healing. May be due to several causes:—(a) fungi, such as Nectria, Glomerella, and Sphæropsis; (b) bacteria; (c) insects, such as Woolly Aphis and Chermes.

(3) **Witches' Brooms** characterized by irregular clusters of twigs at certain affected points. They are due to fungi, such as Exoascus and Aecidium.

(4) **Root Nodules,** irregular growths on rock or at crown of root, may be due to one of several causes; (a) Slime fungi as in Club Root of Cabbage; (b) true fungi; (c) bacteria; (d) insects, and (e) Nematodes.

(5) **Erinoid Growths,** hair-like growths on leaves of poplar, oak, basswood, are due to the action of mites.

(6) **Galls** are enlargements due to the puncturing of young tissues by mites and insects, such as Phytoptus, Aphides, Cynipids, and Cecidomyiids.

Some Deformations and Dwarfing and their Causes:—

(1) **Unequal Growths** on stems or leaves are due to fungi, aphids or mites.

(2) **Dwarfing of a plant** may be due to lack of food material, to insects, or to fungi.

(3) **Leaf-Rolling** is due to insects or mites.

Wilting and Rotting and their Causes:—

(1) **Damping-off** of seedlings is due to fungus (Pythium).

(2) **Rot** of fruits is due to various fungi, such as Monilia, Læstadia, Botrytis, Mucor, Penicillium, bacteria, &c.

(3) **Oedema or Dropsy** is due to excess of water.

Abnormal Coloration or Spotting and its Causes:—

(1) **General Pallor** indicating a disturbance of the chlorophyll tissue, may be due to one or more of several causes: (a) Fungous attacks on roots; (b) insect attacks on roots; (c) insufficient or too intense light; (d) too low or too high temperature; (e) too much or too little water in the soil; (f) lack of iron and other essential food materials in the soil.

(2) **White or Gray Spots** are due to Mildew, Septoria, &c., Cystopus and red spider.

(3) **Yellow or Orange Spots** to rusts, aphids and red spiders.

(4) **Red Spots** to certain stages of Rusts.

(5) **Brown Spots** to blights, leaf spots, mildew and rusts, often a stage of disorganization of affected tissue.

(6) **Black Spots** to apple scab, pycnidial and ascus stages of many sac-fungi, rusts, smuts, &c.

(7) **Brown Spots with Red Margins** to many anthracnoses and strawberry leaf blight.

FUNGOUS DISEASES IN QUEBEC IN 1908.

William Lochhead, Macdonald College.

Fungous diseases were not so prevalent or so destructive in Quebec in 1908 as in previous years, owing, no doubt, to the long continued spell of dry weather that prevailed over the entire province during July, August and September. Most parasitic fungi require moist weather conditions to propagate and spread, and in the absence of such conditions limit their operations to the plants first infected. Moreover, plants growing under conditions of abundant moisture develop succulency; their tissues are overgrown and soft, and fungi cannot only gain easy entrance, but they can also make rapid headway, when once they are within the plant. On the other hand, plants grown under dry conditions develop hard, resistant tissues, and parasitic fungi can make but little progress.

Many persons unacquainted with the habits and life-histories of fungi, and with the real causes of disease, believe that weather conditions of themselves induce fungous disease. As already stated, moist or dry weather are but **conditions** that favor or retard the development of fungi, and in themselves do not induce fungous disease.

Further, many persons are under the belief that the proximity of one fungous disease on one kind of crop may induce disease in another kind of crop. For example, I have heard it maintained that the potato blight will cause rust on wheat or oats. When it is explained to them that potato blight and oat rust are two quite different plants—just as distinct as an apple tree is from an oak tree, and that we might as well expect an apple tree to give rise to an oak tree, their contention becomes absurdly apparent.

It is quite true, however, that certain fungi frequent more than one kind of plant. For example, the wheat and oat rust has also the barberry as a second host, and the brown rot is found on many hosts, such as the plum, cherry, peach, apple, &c.

Following is a list of the most common fungus diseases observed in 1908:—

Diseases of Vegetables.

Anthracnose of Bean (Colletotrichum lindemuthianum)—common, but not seriously injurious.

Club Root of Cabbage (Plasmodiophora brassicæ) is occasionally and locally severe.

Leaf Blight of Celery (Cercospora apii)—quite common but not destructive.

Drop of Lettuce (Sclerotinia libertiana)—sometimes met with.

Early Blight of Potato (Macrosporium Solani)—was quite injurious.
Late Blight of Potato (Phytophthora infestans)—not prevalent.
Scab of Potato (Oospora scabies)—very common.
White Rust of Salsify (Albugo tragopogonis)—abundant.
Strawberry Leaf Blight (Sphærella fragariæ)—common. (Fig. 6).

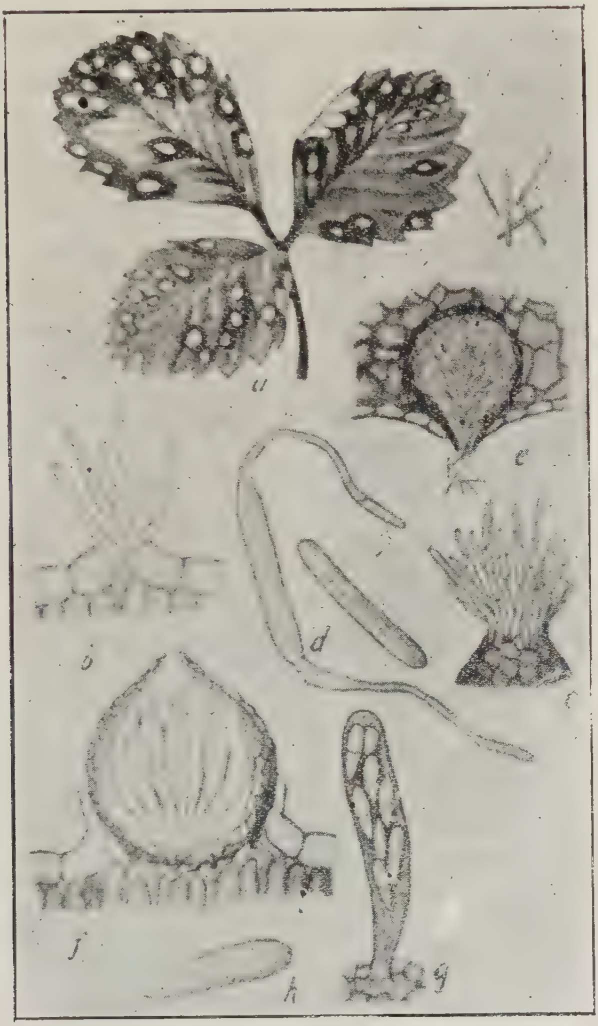


Fig. 6—a, A leaf of strawberry affected with leaf blight; b, spore bearing tuft of mycelium-bursting through the epidermis of the leaf; c, summer spores arising from apex of a resting spore case; d, summer spores (conidia), one germinating; e, section of a spore pustule (spermogonium) produced in summer; f, section of resting or winter spore case (perithecium), found in tissues of old diseased leaves which have lain on the ground over winter; g, a spore sac (ascus) containing eight two-celled winter spores; h, a winter spore (ascospore) very highly magnified. (Longyear.)

Diseases of Small Fruits.

Anthracnose of Blackberry (Glœosporium venetum) was prevalent but not injurious.

Leaf Spot of Raspberry (Septoria rubi)—quite prevalent but not injurious.

Orange Rust of Raspberry, &c. (Gymnoconia interstitialis)—does considerable damage every year.

Anthracnose of Currant (Glœosporium ribis)—was common but not very injurious.

Leaf Spot of Currant (Septoria ribis)—more or less common on currant and gooseberry.

Powdery Mildew of Gooseberry (Sphærotheca mors-uvæ)—common on English varieties. (Fig. 7).

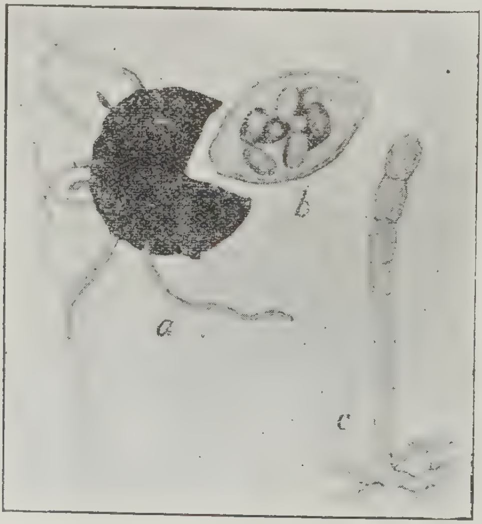


FIG. 7—Powdery mildew of gooseberry. a, A resting spore case (perithecium), discharging its single spore sac (ascus) which contains eight winter or resting spores ; c, the summer spore stage of the disease, showing a spore stalk (conidiophore), which divides, thus forming spores which soon fall apart ; magnified. (Longyear.)

Plum and Cherry Diseases.

Black Knot (Plowrightia morbosa)—was common throughout the province.

Brown Rot (Sclerotinia fructigena)—more or less prevalent.

Shot-Hole (Cylindrosporium padi)—more or less prevalent but not seriously injurious.

Plum-Pockets (Exoascus pruni)—was quite severe in some localities.

Apple Diseases.

Bitter Rot (Glomerella rufomaculans)—was occasionally met with, but was not injurious.

Black Rot or Canker (Sphæropsis malorum)—was quite prevalent in the canker form in many orchards, and is doing much damage.

Blight (Bacillus amylovorus)—was locally quite injurious.

Crown Gall (Dendrophagus globosus)—was sometimes found in apple nursery stock.

Leaf Spot (spp.)—was prevalent but not injurious.

Scab (Venturia pomi)—was quite prevalent, especially on Fameuse apples.

Diseases of Cereals.

Rust of Corn (Puccinia maidis).

Smut of Corn (Ustilago maidis).

Rust of Oats, Barley and Wheat (Puccinia graminis)—common.

Smut of Oats (Ustilago avenæ).

Loose Smut of Wheat (Ustilago tritici).

Powdery Mildew of Wheat (Erysiphe graminis).

These fungi were commonly met with. The smuts and rusts do much injury every year.

Diseases of Ornamentals.

Rust of Aster—not common.

Rust of Carnations (Uromyces caryophyllinus).

Powdery Mildew of Lilac (Microsphæra alni).

Leaf Blotch of Rose (Actinonema rosæ).

These and other diseases were common, but produced no serious effects.

Mr. J. C. Chapais of St. Denis, to whom I am much indebted for information as to the distribution of the plant diseases in Quebec, states that Brown Rot, Melon Mildew and Orange Rust have not yet been observed east of Quebec City.

WEEDS AND WEED SEEDS.

Douglas Weir, Macdonald College.

There is perhaps no matter of greater practical concern to the Canadian farmer than weeds and their control.

It has been frequently remarked that **weeds** have formed and will continue to form a **natural** crop. But it should be remembered that weeds are a foreign and not a native crop. They have secured an uninvited entrance into our fields and farms, militating against useful plants, robbing the soil of nutriment, and in other ways too well known, occasioning enormous waste and loss.

Let us consider how weeds may be checked and eradicated. It is, of course, the very nature of plants to grow, and equally natural that the soil should bear them, otherwise no life were possible. Why not, then, adopt the method suggested by weeds themselves, and plant native and cultured crops to oust them from the land and occupy it in their stead? A judicious use of green cover-crops after harvest is a well-known method. By such means, a large proportion of the available soil-food would be absorbed, and when, in the late autumn, the crop is ploughed under, the tilth of the soil will be vastly improved and its nutritive value doubled.

Intelligent farmers are now agreed that the most efficient means of combating these " Levites of the field " is to play them at their own game. By planting hardy, vigorous Canadian, or well-bred foreign seed, both for our crops and to occupy the land after harvest, we can prevent weeds from obtaining a stronghold by forcible possession and also by dispossession.

Let us pass next to a consideration of the exact loss of soil elements occasioned by weeds. For the purpose of illustration, we select that widely distributed weed " **Amarantus retroflexus** " variously known as Pigweed, Reedroot, or Barnyard Weed.

After careful chemical investigation, it has been ascertained that a ton of this weed, dried in the air, contains five times as much Potash, twice as much Nitrogen and an equivalent amount of Phosphoric acid as a ton of manure.

Ponder a moment the extra dollars and cents we might have in our pockets, or the more up-to-date machinery on our farms if this energy were stored up in grain, grass and root-crops, instead of in weeds. Further, this ton of Pigweed contains as much Potash as seventy-five bushels of wheat. as much Nitrogen as twenty bushels, and as much Phosphoric acid as fifteen bushels.

When we consider the astounding prolificacy of weeds, in addition to their other ruinous extravagances, the problem they present assumes even more alarming proportions. For example, a single plant of Pigweed produces 150,000 to 800,000 seeds; a single Purslane plant anywhere from 400,000 to 2,000,000; the burr of a Burdock—the cause of so much misery to animals—contains only fifty seeds, but when each of these develops into a plant capable of producing eight hundred burrs or 40,000 seeds, its importance in agricultural economy, can, perhaps, be readily appreciated.

The necessity of an abundance of water for the proper development of plants throughout their entire growing period, is appreciated by all; and yet, here again the loss entailed by weeds is strikingly illustrated.

For every pound of increase in the dry substance of plants about 300 pounds of water is transpired, which in a dry Canadian summer constitutes a serious waste.

Further illustrations are unnecessary, and enough has already been said to show the necessity of stubbornly attacking "weeds," and the importance of co-operation among neighbouring farmers. Usually, the more intensive the farming the more completely are these pests held in subjection.

I have already said, that many of our most injurious weeds are introduced from foreign countries. Constant care should therefore be exercised to exclude any new-comers that may likely prove injurious in the future, for distribution through the agency of wind, water, railways, birds and other animals may be astonishingly rapid. Many weed seeds are capable of effectively withstanding the gastric juices of the stomachs of animals, and being passed out of the body in the fæces, cause another common source of distribution, both directly and by being sold in manure.

Again, besides interfering, as we have seen, with the proper relation of crops, weeds harbour spores of injurious fungi, and in many cases serve as the temporary host plants of insects which later deposit their eggs upon, or migrate to, the crop under cultivation. However, the greatest medium through which injurious weeds are disseminated, undoubtedly is the buying and importation of seed. Fortunately, this is one that may be avoided. Farmers, therefore, should endeavour to become familiar with the seeds of weeds. Many of us have a very limited knowledge of weed seeds, and frequently fail to recognize dangerous ones on their first appearance. We cannot lay too great emphasis, therefore, on this subject of "pure seed." The old maxim "one years' seeding, seven years weeding," is undoubtedly sound.

Recognizing the great national importance of these facts, the Federal Government, upon the recommendation of their Agricultural experts, have enacted, "The Seed Control Act," respecting the inspection and sale of seeds. This Act came into force September 1st, 1905, and makes it an indictable offence for any person (1) "to sell, or offer, expose or have in his possession for sale, for the purpose of seeding, any seeds of cereals, grasses, clovers or forage plants, unless they are free from any seeds of the following weeds:—

Bindweed.
Wild Oats.
Field Pennycress, or stink weed.
Ball mustard.
Hare's Ear mustard.
Tumbling mustard.
Wild mustard, or charlock.
Perennial Sow-Thistle.
Ragweed.
Great Ragweed.
Purple Cockle.
Orange Hawkweed, or Paint Brush.
Ergot on Rye.

The offence lies unless each receptacle containing the seeds is marked in an indelible manner with the name and address of the seller, and the common names of the impurities. Nor does the offence lie, when the seed is grown, sold and delivered by a farmer on his own premises, for seeding by a purchaser himself, unless the vendor certifies that what is supplied, is subject to the Act.

It is also an offence for any person (2) "to sell, or offer, expose or have in his possession for sale any seeds of timothy, red clover, alsike, or any mixture containing these seeds, marked No. 1, or other designation of first quality" unless free from the previously mentioned fourteen and the following nine weed seeds:—

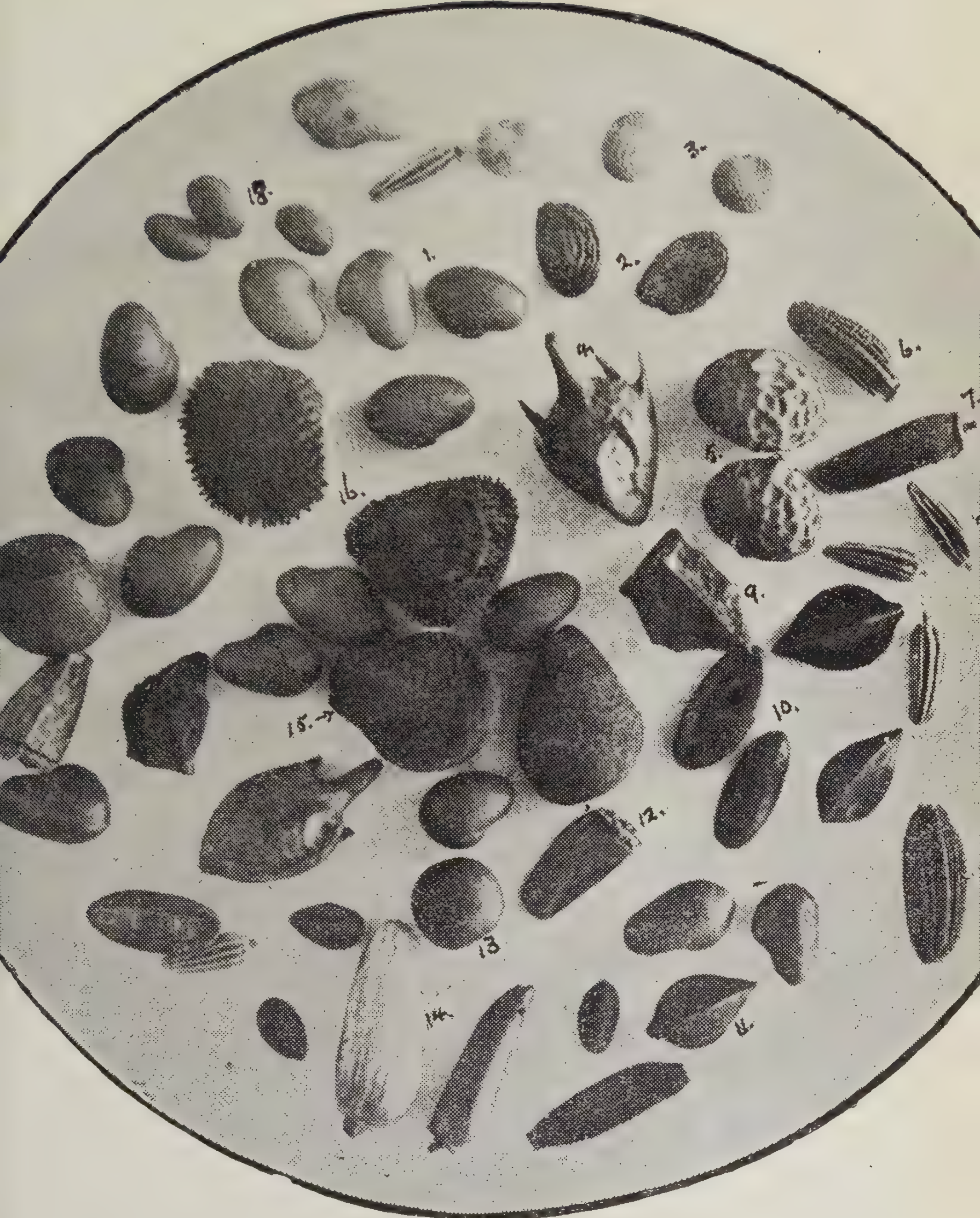
False Flax.
White Cockle.
Canada Thistle.
Night-Flowering Catchfly.
Ox-eye Daisy.
Curled Dock.
Blue Weed.
Ribgrass.
Chicory.

If 99 p.c. of the seed is pure, 90 p.c. germinable, and not more than five of the above weed seeds for every thousand of the seeds offered, there is no offence.

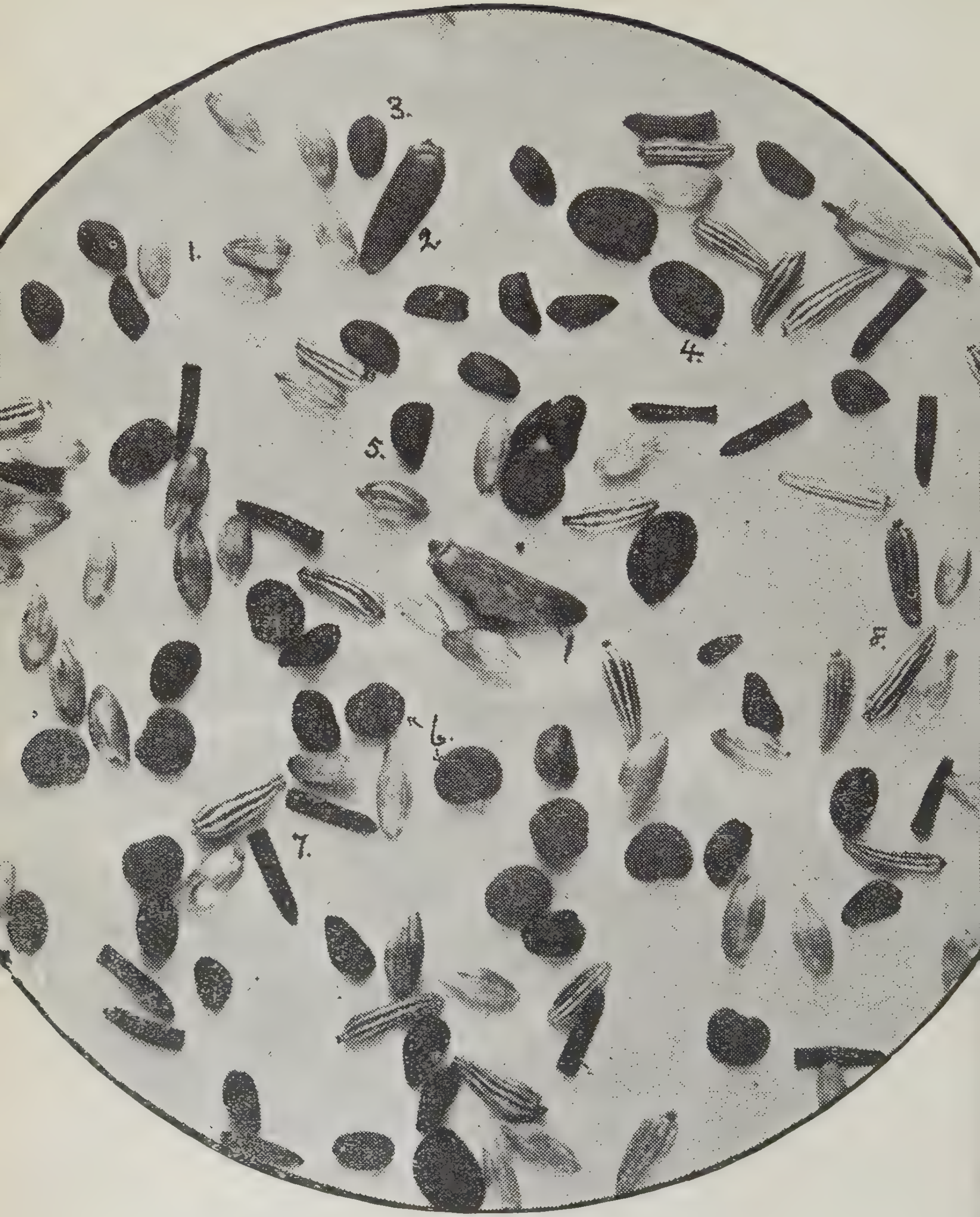
The provisions of the Act do not apply "to persons growing or selling seeds for the purpose of food; selling seeds to merchants to be cleaned or graded by them, or seeds held in storage for the purpose of recleaning, and which have not been offered for sale; and finally, seeds marked 'not absolutely clean' and held or sold for export only."

Having just and efficient laws to govern this important matter, it now rests with the farmer to co-operate in the practical application of these laws.

I submit two photographs which show specimens of the various weed-seeds mentioned mixed with timothy and clover seeds respectively. These may assist the farmer to identify some of his greatest enemies.



1. Red clover.
2. Field Pennycress, or stink weed.
3. White cockle.
4. Common Ragweed.
5. Ball mustard.
6. Perennial sow Thistle.
7. Canada Thistle.
8. Ox-eye Daisy.
9. Blue Weed.
10. Ribgrass Plantain.
11. Curled Dock.
12. Chicory,
13. Wild mustard, or charolck.
14. Bull Thistle.
15. Field Bindweed.
16. Purple, or corn cockle.
17. Cow cockle.
18. False Flax.



1. Timothy.
2. Canada Thistle.
3. False Flax.
4. Field Pennycress.
5. Wormseed mustard.
6. Night-flowering Catchfly.
7. Orange-Hawkweed.
8. Ox-eye Daisy.

ANGUILLULAE OR EEL-WORMS

(ANGUILLULA HETERODERA.)

By J. C. Chapais, St. Denis (en-bas).

SUMMARY.—A geranium disease.—Anguillula Heterodera, its cause.—A short nomenclature of Anguillula.—Anguillula Heterodera, its description and habits.—How to fight Heterodera.

A geranium disease.—Out of necessity, I have just made a special study of certain small round worms which had never much caught my attention till now. I mean to speak of Anguillulæ, or eel-worms, and though the study I have made of them is far from complete, I have thought that perhaps it would prove of some interest to a few of the members of this society.

One year ago a fine ivy-geranium, bearing an abundance of beautiful flowers the year round, and of which I was very proud, began to wither away. The leaves, when they were beginning to grow on the plant, seemed to be thrifty, but as soon as they began to spread, showed thickened and discoloured patches. The plant has lost its beauty, grows in a miserable way, blooms poorly, and the disease is refractory to all the remedies I have used against it.

Lately, I began to study that case, my attention being directed to it by a paragraph I read in the American horticultural review, "Floral Life," which gave me the key to the situation of that apparently insoluble problem of my geranium disease.

Anguillula Heterodera, the cause.—Now that I have investigated and understand that disease, I know that it can attack a large number of our garden and hot-house plants and I think it is well to communicate to others what I know about it. As an anguillula is the cause of the disease of my plant, I will first indicate the place that this queer and noxious worm occupies in the animal kingdom.

Its specific name is "Heterodera." It belongs to the genus "Anguillula," family "Anguillulidæ," order "Nematoideæ," phylum "Nemathelminthes."

A short nomenclature of Anguillulæ.—Before going into details respecting this particular species of anguillula, I will mention, meanwhile, the few species of this genus with which I have become acquainted, while I was studying it. They are:

Specific Latin names.	English names.	French names.
1. Anguillula acetri.	Vinegar ell.	Anguillule du vinaigre.
2. Anguillula glutinosa.	Sour paste ell.	Anguillule de la colle de pâte.
3. Anguillula coralis.	Stercoracious eel.	Anguillule stercorale.
4. Tylenchus devastratrix.	Clover stem ell-worm.	Anguillule de la tige du trèfle.
5. Tylenchus tritici.	Blighted wheat ell.	Anguillule du blé niellé.

I find that two others are mentioned but without anything well specified, viz.: The Diplogaster and the Rhabdonema.

I have no intention of going into details with regard to these seven species of Anguillula. Besides, their names indicate more or less where most of them are to be found, except the stercoraceous eel, which is the cause of a disease called Cochinchina diarrhæa, which trouble foreigners who go to live in India; the Diplogaster, which is found in damp soil, and the Rhabdonema, which is an animal parasite. Most of them are so tenuous that the naked eye can not see them, and so is the Anguillula Heterodera or eel-worm, of which I now give the following description.

Anguillula Heterodera, its description and habits.—Eel-worms (Anguillule hétérodère, French). Male showing a buccal spicule, female with a prominent posterior end of body, the anterior having a spicule. Living in the roots and leaves of Amaryllis, Geraniums, Carnations and Violets.

This worm is a small microscopic creature which worms itself in the parenchyma of leaves, and which is often found in nodules or excrescenses that it generates on the roots of the plants on which it lives. It is seldom met with, but it is much to be feared once it has shown itself on a plant, for it is impossible to harm or hit it with remedies ordinarily used against insects. Its presence is indicated by the thickening of some parts of the leaves which take a yellowish tinge and a dusty and sickly appearance. The under surface of those faded leaves exudes a sticky or slimy substance, looking like a gumarabic sediment.

These worms are seldom found in soils containing a fair quantity of lime.

How to fight Heterodera.—First, it is right to mention the fact that if we make a rule of freezing at a very low, or heating at a very high, temperature the soil in which we pot our plants, we are sure to kill all the Heteroderas it may contain. As to the diseased plants, we must remove and burn all the leaves showing the presence of the worm, for if we omit to do that, the whole plant will soon be infested. Should this be the case, we must then have recourse to an heroic remedy, draw the plant from its pot, shake all the soil from its roots, wash the roots as well as the stem and leaves in water as hot as the hand can bear it, and replant it after having previously washed the pot very carefully, and made a point of using only soil absolutely sterilized by cold or heat (heavy frost or boiling water). After this operation, every time one of the new leaves show, when beginning to grow, traces of infection, it must be pulled away, burnt and the plant should be washed thoroughly.

A gardener mentions as a specific against Heterodera, the following prescription: Put an ounce of nitrate of soda and the third of a wine glass of carbolic acid in two gallons of water; place the potted plant for a period from three to six hours in that mixture, and leave them drip until well dry before putting them back in their place. I must say that I have not yet tried that experiment, but it seems worth trying.

SOME INSECTS AFFECTING THE APPLE.

J. M. Swaine, Macdonald College.

The most important enemies of the apple throughout this Province are the Codling-moth, the Plum Curculio, the Apple Maggot, and the Rounded-headed and Flat-headed Borers.

The Codling-moth is better known to the orchardist than any other injurious insect. The loss due to its work varies from one-quarter to one-half the apple crop throughout the greater part of the apple-growing region of America. (Fig. 10).

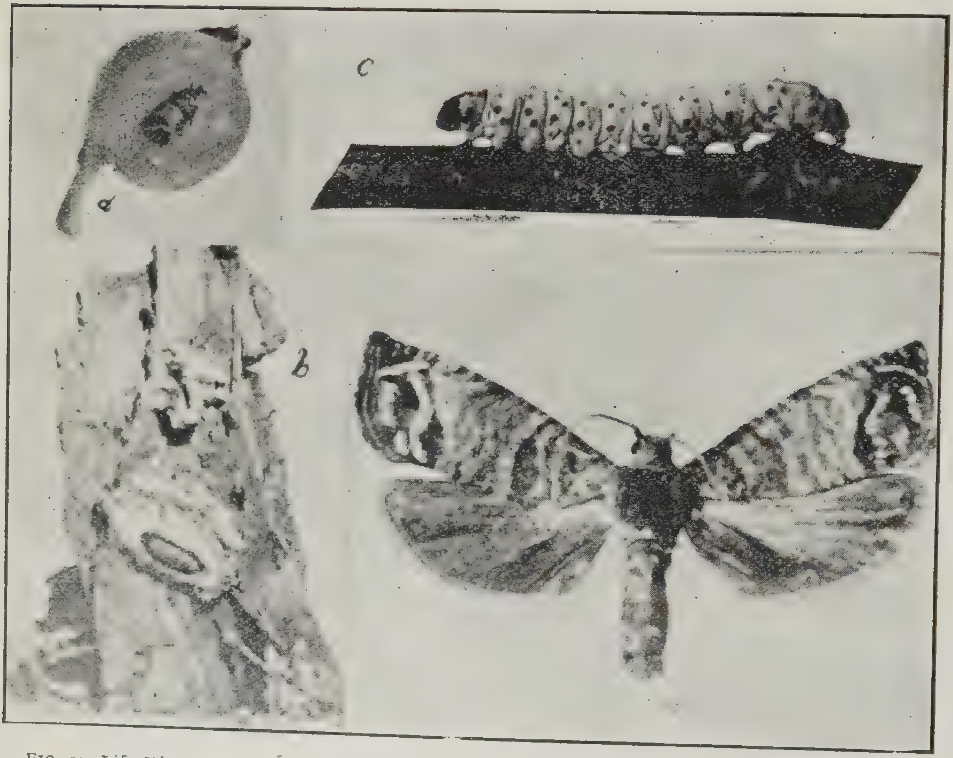


FIG. 10—Life History of the Codling Moth. (Carpocapsa pomonella, Linn.) a, adult, x 4; b, pupa in cocoon on under side of loose bark; c, Codling-worm (larva), x 3; d, adult and egg on the fruit. (a, from Slingerland: b, c, d, from Simpson.)

In New York State the annual loss to the apple and pear raising industry, from this insect alone, was estimated by Prof. Slingerland at $3,000,000. Apples and pears are most commonly affected, but the insect also breeds in wild haws, crab apples and quinces, and rarely in peaches and cherries.

The life-history is briefly, as follows: The moths appear in spring, a few days after the apple blossoms have fallen. The eggs are laid, usually singly, attached to the skin of the apple, or to the stem, or often to the leaves. The eggs are laid within a week after the falling of the blossom petals, and hatch in from four to ten days.

The young larva or worm may, if hatched thereon, feed for a short time upon the leaves, but they soon find their way to the fruit, to breed within it. The worms may enter the apple at any point; at the stem end, through a curculio scar, at the meeting point of two apples which touch, or at any point on the skin; but it has been demonstrated that over seventy-five per cent. enter through the blossom end. After feeding for several hours in the calyx-cup, which has by this time closed, or after feeding for a short time within the skin, wherever they may have entered, the worms usually bore directly towards the core, spinning a silken thread wherever they go. The caterpillar feeds within the fruit for 20 to 30 days, after which it bores directly towards the surface of the apple, plugs up the hole with silk and frass and retires within the cavity for several hours longer. Finally it removes the plug and escapes to the limb or to the ground, whence the majority find their way eventually to hiding-places in crevices or under bark on the apple-trunks. Usually about half the worms leave the apples before the latter (windfalls) drop, and the remainder usually within a day or two. As stated, the majority of the worms hide in crevices upon the apple-trunks, if such hiding-places are present; the others hide in cracks in fences, under boards or elsewhere.

Within these hiding-places the worms spin a case or cocoon of silk, in preparation for the resting or pupal stage. Those emerging from packed apples spin their cocoons within the packages; as many as a hundred have been found within one barrel. This explains their rapid distribution throughout the country.

In all but the southern portion of Quebec, larvæ of the first brood remain within the cocoons until spring. Then, during the warm days of late spring the larvæ change to pupæ (chrysalids), in which state they remain for two or three weeks. At the end of this time, during which the organs of the adult moth have been rapidly perfected, the moths emerge through the cracked skin of the chrysalis and prepare for egg-laying. Few moths appear before the petals of the apple blossoms begin to fall, though their period of appearance may extend over several weeks.

In the southern part of Quebec—the limits of the region are not known to me— a portion of the worms turn to chrysalids shortly after the cocoons are formed, and three weeks later the moths appear to lay eggs upon the half-grown apples for a second brood. This accounts for wormy apples found late in the season. The worms of this partial second brood enter the apple at any point on its surface, and commonly feed about beneath the skin for some time, carving a shallow chamber, and causing an unsightly scar, before finally piercing to the core.

Information as to the prevalence of wormy apples late in the season in any part of Quebec, and any items of interest relating to this partial second brood will be gratefully received by the Society.

Remedies.—The larval stage is the only one open to effective attack. Trap lanterns and poisoned baits for the moth have proved useless. Poison-sprays afford the best method of control where only one brood occurs, and Paris green and lead arsenate are the poisons most used for the purpose. Inasmuch as 75% or over of the worms enter through the blossom end of the apple and get their first meal within the calyx cup, the main object of spraying should be to fill this cup with poison and so kill the greater portion of the worms. But about ten days after the blossom petals fall the calyx leaves close over the cup, and the young apple turns down on the stem. After this has occurred spraying will not be nearly so effective. Hence the rule: "Spray with poison within ten days after the blossom petals fall." Many experiments have proved beyond doubt that when this one spraying is thoroughly done, and in time, the greatest injury from Codling Moth is averted. If a heavy rain occur within a week, the spray should be repeated. Many consider it advisable to spray again ten days later. The first spray is by far the more important and should never be omitted. (Fig. 11).

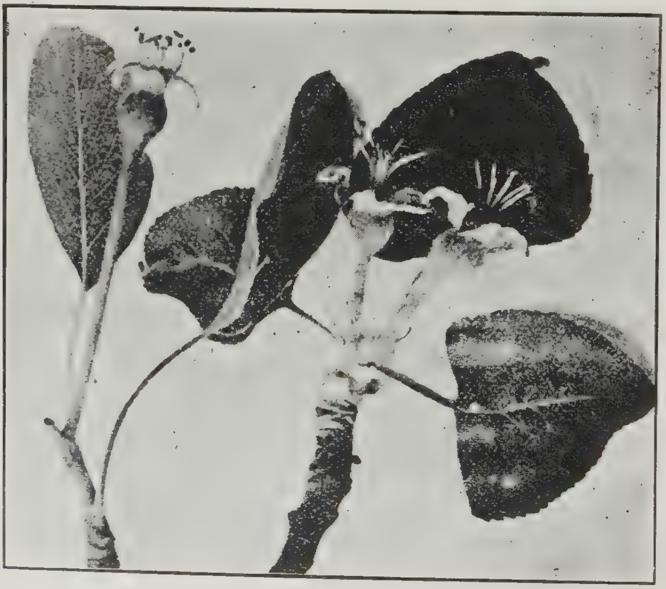


FIG. 11—Just right to spray. A pear and two apples from which the petals have recently fallen. Note that the calyx lobes are widely spread. Spraying time for Codling Moth. (After Slingerland.)

As Prof. Slingerland has said: "The important thing for the fruit-grower to do is to watch the blossoming of his tree and the developing of the young fruit, and not depend on anything or anybody else. Simply see to it that there is a good dose of poison put into each blossom-end and that it is not washed out by rains before Nature gets it protected with the closed calyx lobes."

The cost of spraying per tree should be less than ten cents for the season. As the orchardist has also to spray Bordeaux Mixture for Apple Scab Fungus it is always advisable to mix the two solutions, and make one spraying suffice. This poisoned Bordeaux is made by adding 4 ozs. Paris green to 40 gallons of Bordeaux Mixture. The formula for Bordeaux Mixture is given in another place in this report.

In this Province the two sprayings just suggested should insure against serious injury from Codling Moth. If, however, in the southern part of the province the partial second brood does any considerable damage it will be better to band the trees in addition to spraying. During the first week in June tie or tack around the trunk of each apple tree a strip of sacking or waste cloth, or even thick paper, about six inches wide. Under these strips very many of the larvæ which have escaped the poison (15-20% are almost sure to escape, viz., those which enter elsewhere than at the blossom end) will hide to pupate. The bands should be removed, and all cocoons and larvæ destroyed every ten days, and the bands replaced.

The Plum Curculio is second in importance in this province among insect enemies of the apple fruit. It has usually been credited with a preference for plums, and undoubtedly prefers them as a rule. However it readily attacks apples, and is locally a serious pest. At Chateauguay the Curculio has been even more injurious than the Codling-Worm. At Macdonald College it has so far been rarely found in the apples, although last year it destroyed practically every plum on two trees in the corner of an apple orchard. (Fig. 12).

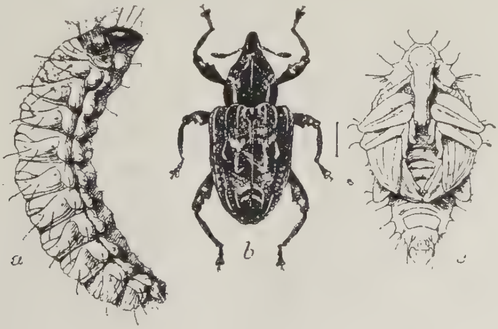


FIG. 12—The plum curculio (Conotrachelus nenuphar): a, larva; b, adult; c, pupa. Much enlarged (hair line to right of b indicates natural length of adult). (From Chittenden.)

The adults winter under refuse and among the grass-roots beneath the trees. Early in spring they appear and feed on the opening buds, and later on the leaves and young fruit. The eggs are laid in slits cut into the fruit usually soon after it has set, although egg-laying lasts over several weeks. The young grubs feed mainly about the central portion of the fruit. The larvæ or grubs are legless, and may be thus distinguished from the caterpillars of the Codling Moth, which have three pairs of legs attached just behind the head, and five pairs of abdominal prolegs.

The grubs leave the fruit usually after the latter has fallen, and enter the soil. Here they form an earthen cell and pass the pupal stage, to appear four weeks later to continue their work of destruction.,

Three methods may be followed in the control of this pest. On plums and small apple trees **jarring** is commonly practised. This consists in jarring the trees with a padded mallet over a large cloth spread beneath the tree. The beetles drop upon the sheet and are gathered and destroyed. On large apple trees this is not practicable. The second method consists in gathering promptly and destroying the windfalls. If thoroughly done, this insures to a considerable extent against the next brood. It is certain that in this Province it invariably pays to promptly destroy all windfalls of apples and plum, either by feeding to stock or by burying in deep pits. In apple orchards, and probably also in plum orchards the main dependence should be upon poison sprays. When the regular sprayings with poisoned Bordeaux for fungus pests and Codling Moth are thoroughly applied to apple trees, and the windfalls destroyed promptly the Curculio rarely does serious injury. For Curculio, plums should be sprayed three or more times, depending upon the wetness of the season and the thoroughness of the application. The standard strength of Paris green or lead arsenate should be used. The first application should be made as soon as the fruit is nicely formed. The object of the poison is of course to kill the beetles as they feed on the fruit, or earlier in the season on the buds. As they eat but little of the surface, it is necessary to have the poison strong, and to apply it thoroughly. As the eggs are laid in a slit through the skin, and the grubs feed entirely within the fruit, the only methods of control have reference to the adult.

The Apple Maggot or Railroad Worm.—This injurious species occurs locally in this Province. It is injurious at Como, and at various places in the eastern townships. Its first appearance should incite to the most earnest efforts for its eradication. The young or maggots bore small holes throughout the fruit in all directions, and render it quite worthless. Apples may appear perfectly sound, but when cut open, may reveal the numerous brown streaks caused by the maggot in its burrowing. By these fine borings its work may be identified. The maggots are small, legless, one-fourth of an inch in length when full grown, tapering gradually towards the very small head, and abruptly truncate behind. It is thus easily distinguished from the larva of the codling-moth and of the plum curculio. The adults are two-winged flies with banded wings, somewhat smaller than the house-fly. The eggs are inserted through the skin of the apple. After the apples have fallen the maggots leave the fruit and pupate in the soil. The only method of control is to gather the fallen fruit before the maggots leave to enter the ground. After the eggs are laid there is no way of preventing the injury; and at present no way is known of effectively preventing oviposition. However, as the flies travel only a short distance and seem to be spread mainly by infested fruit, it is possible to confine the trouble to even a small portion of the orchard. If convenient to keep hogs in the orchard they can be depended upon to destroy the greater portion of the windfalls. With this pest, however, I should take no chance, but have remaining windfalls gathered each day and buried in a pit, covered with quicklime and plenty of earth.

The Round-headed Apple-tree Borer, (Fig. 13).—The larva or grub of this most serious pest bores in apple trees of all sizes, but does the greatest damage to small stock. The adult is a beautiful beetle, three-fourths of an inch long, yellowish-brown above, with two white stripes down the back. The eggs are deposited in June through slits in the bark near the base of the tree. The young grubs tunnel the sap-wood and gradually work down to near the surface of the ground. Here they rest during the first winter. In the spring they continue their feeding, thrusting bits of wood particles through holes made in the burrows. During the latter part of this second season they bore deeper into the heart-wood. They continue

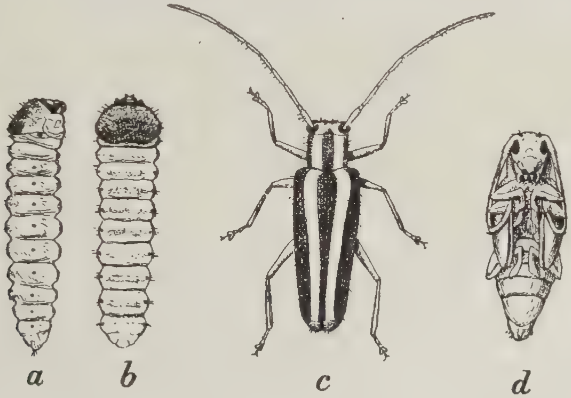


FIG. 13—The Round-Headed Apple-Tree Borer (Saperda candida Fab.): a, larva, from side; b, from above; c, female beetle; d, pupa—all enlarged one-third. (From Chittenden.)

their operations throughout the third year, finally boring out to the bark, where they form a pupal cell, and the next spring change to pupæ. After about twenty days the adults emerge from the pupal skin, cut a round hole through the bark, and appear a little less than three years after the depositing of the eggs from which they were hatched. The orchard, especially the young trees, should be regularly examined through the late summer and autumn, for these and for the flat-head borers. Prevention is, in the case of this insect, much better than cure. The best method consists in protecting the base of the tree by a paper or wire netting, and the upper portion of the trunk by alkaline washes. The trunk should be carefully scraped. Thick wrapping paper or wire gauze should be fastened about the base of the trunk for a distance of two feet from the ground, tied with twine or tacked above, and hilled up with earth below. The paper should be tied below before hilling. The wire, if used, should be spread far enough from the tree to prevent egg-laying through the meshes. Paper will last for one season, wire for several. This prevents egg-laying on the base of the trunk, and prevents the exit of any insects then in the wood. Above this protection an alkaline wash should be coated well up on the large branches. This should be done before the first of June. Cutting out the borers with a sharp knife or killing them with a wire thrust into the borings is often practicable. This should be done during the late summer and early fall, while the grubs are small and near the surface. Kerosene or carbon bisulphide injected into the borings will kill those grubs beyond reach of the knife or wire. In this connection, it should be remembered that there is no object in injecting kerosene into the holes through which the beetles have escaped, nor in cutting away all the sap-wood for the sake of killing the borer. Injuries to the sap-wood can be bridged by bits of fresh twig, split, bevelled on the inner sides of the ends, and sealed in place with grafting wax.

The Flat-headed Apple-tree Borer.—The grubs of this species attack mainly the upper portion of the trunk and the bases of the larger branches. They do most damage to young trees, and seem to prefer trees which have been injured or are diseased. The grubs are flattened and much widened behind the head, and may be thus distinguished from the grubs of the round-head borer, which are more nearly cylindrical.

The eggs are deposited in early summer upon the bark. The grubs bore through the bark and carve a flattened chamber in the under bark and sap-wood. The bark above this cavity dries, cracks, and through these cracks the castings are thrust. During the latter part of the season the grubs usually bore deeper into the wood, coming finally in the spring to the surface, where the pupal cell is cut. About three weeks are spent in the pupal stage, after which the adults appear through oval holes cut in the bark. The beetles are about half an inch long, flattened, and metallic brown in colour. (Fig. 14).

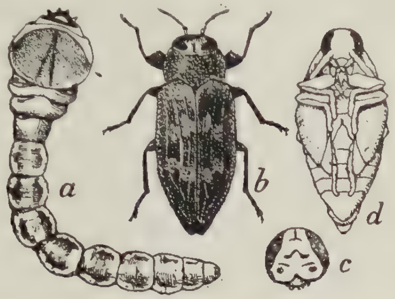


FIG. 14—Flat-headed Apple-tree Borer, (Chrysobothris femorata, Fab.): a, larva; b, adult; c, front of head; d, pupa. Enlarged. After Division of Entomology, U. S. Department of Agriculture.

Remedies suggested for the round-headed borer control this pest. Where common, special care should be taken to apply the wash as far up the tree as possible. Mr. Chittenden has suggested placing branches or trunks of newly felled oak or maple, in which the beetles also breed, at intervals about the sides of the orchard. These may attract the borers from the apples, and should be burned before May of the following year.

A point well worth emphasizing in this connection is the part played in the distribution of orchard insects by neglected fruit trees. Everywhere throughout this district one meets, here and there, with isolated apple trees, or even small orchards, abandoned to their enemies. These old and diseased trees are most perfect breeding places for insects and fungi, and serve as centres of distribution of apple insects and fungi for the neighbourhood. The same applies to dead and dying wood in cultivated orchards. All fruit trees of little or no value, all dead and dying branches, and all fallen fruit should be destroyed as soon as possible in such a way that contained insects could not escape.

Insecticides.—A few good formulæ are inserted here. Bulletin 52 by the late Dr. Fletcher of the Central Experimental Farm, Ottawa, and Bulletin 121 of the Ontario Agricultural College, Guelph, Ontario, by Prof. Lochhead, give excellent accounts of the preparation and application of insecticides.

Paris Green on Fruit and Shade Trees.

Paris green	1 lb.
Unslacked lime	1 lb.
Water	160 gallons.

Lime should always be added. On potatoes one pound to fifty gallons of water or even a stronger mixture may be used.

When possible, Paris green should be applied with the Bordeaux Mixture. (See Poisoned Bordeaux).

Paris Green as a Dry Application.

One pound of Paris green thoroughly mixed with 50 lbs. waste flour or other fine and dry powder.

Poisoned Bran for Cut-worms, &c.

Four ounces of Paris green mixed thoroughly with 25 lbs. of moistened bran.

Hellebore.

Used undiluted as a powder, or as a spray at the strength of one ounce of hellebore to two gallons of water.

Pyrethrum Powder (also called Insect Powder, Dalmatian Powder or Buhach).

Used as a spray: one ounce of powder and three gallons of water.

Used as a dry application: one part of powder carefully mixed with four parts of flour and kept in a tight can for one day. Dust on plants, while they are wet, with a powder gun or from a bag of coarse sacking.

Kerosene Emulsion.

Soap (fish-oil or other)	½ lb.
Kerosene or crude oil	2 gallons.
Hot water (soft)	1 gallon.

Dissolve the soap in the hot water, add the oil, and churn violently until a thick, creamy emulsion is produced. This gives the stock solution, which will harden on cooling, and may be kept for some time. For use it must be diluted with nine or more parts of water. Warm water is better.

Shutt's Flour Kerosene.

Flour	8 ozs.
Kerosene	1 qt.
Water	2 gallons.

Scald the flour and mix thoroughly with the kerosene. Add the water and churn violently until a creamy emulsion is produced. This is ready for use. The churning is best done with the pump by driving the liquid back into the barrel.

Alkaline Wash for Borers.

Washing soda—saturated solution.
Soft soap—to make a thick paste with the soda.
Crude carbolic acid—1 pt. to 10 gals. of wash.
Paris green—½ lb. to 10 gals. of wash.

Apply to the trunks and larger branches not later than the first of June.

Tobacco Decoction.

Refuse tobacco	2 lbs.
Water	5 gallons.

Boil for a half-hour, keep covered till cool, and apply undiluted. For plant lice, and as a contact insecticide generally.

Whale Oil Soap.

One pound fish oil in five gallons of water. For plant lice and scale insects.

Poisoned Bordeaux Mixture.

Copper sulphate	4 lbs.
Quick-lime	4 lbs.
Paris green	4 ozs.
Water	40 gallons.

In small quantities:

Copper sulphate	4 level tablespoonfuls.
Quick-lime	4 " "
Paris green	1 " "
Water	1 pail (2 gals.)

Directions for the preparation of Bordeaux Mixture are given in another paper in this report.

ECONOMIC INSECTS.

Report of Montreal District—Albert F. Winn, Westmount.

When I was appointed member of the council to report the Montreal District, I feared that more time might be required of me than I had to devote to the work; but the past season appears to have been a **pestless** one, as officially nothing whatever has been reported to me, so that the position has been a sort of sinecure. When the objects of this Society become better known, I feel sure that each year will show that more and more specimens will be submitted to the officers and more questions asked as to what are enemies and what are friends, and reports on these and the best means of dealing with them, will form interesting topics for discussion.

In the absence of such, on this occasion, I think it might not be out of place to say something about some of the insects one might expect to have some enquiries about—the insect pests of a great city.

At the present time, a moth is appearing in our house which is always a troublesome fellow—the clothes moth (Tinea biselliella), which always selects in our cupboard and drawers the garments we wear least often, and frequently our best, and its larva nibbles out an irregular hole, which would defy anyone to repair. There are also a host of other household pests, cockroaches, beetles, and sundry other insects of a still more undesirable nature, which I need not mention; but possibly, no probably, the worst of all is the house fly, and its near relation, the stable fly. These insects should be waged war on relentlessly by everyone. Whether they are responsible in a degree for the very numerous cases of typhoid fever that we had about Montreal in the early Autumn or not I am not able to say definitely, but as suspicious characters these have no equal. Living as they do in their early stages in horse manure, and as adults revelling in every disgusting form of animal and vegetable refuse, these "insects that don't wipe their feet," as they have been called, fly into our houses, walk over our sugar, meat, vegetables, &c., and finally die in the milk jug, on the soup, as likely as not, or get served up to us, germs and all, in various ways.

As regards enemies to our large and beautiful shade trees about Montreal, we are fortunate in so far having escaped the important pests that have so troubled our friends in the United States cities. I refer to the Leopard Moth about New York, and the Gypsy Moth, the Brown Tail

Moth, and the Oriental Moths about Boston, and throughout the New England States. But it does not do to be too confident that we will always be exempt from them, and I constantly fear that the Brown Tail Moth will cross our border and work havoc among our apple orchards, as it has spread with alarming rapidity throughout Maine and into Nova Scotia.

Up to the present time, the trees in Montreal streets and parks have suffered more at the hands of human beings than from insects, and this winter more from the wind and weight of ice on the branches than from everything else combined, and many of our trees should have careful attention at the right time, cutting off evenly and painting over the exposed ends from which boughs and branches have been torn, and receive proper pruning to make the trees again present symmetrical form.

Among the insects that make themselves conspicuous on our shade trees, the Fall Web Worm (Hyphantria textor) is the one our City Fathers should look after. Every Fall the trees on our streets are festooned with the great ugly webs full of caterpillars which might easily be removed and destroyed. Of course now and then these moths lay their eggs high up among the tops of the elm trees, and nothing short of sky rockets would be likely to reach them, but these are the exceptions, and if those which could be got at by ladders of reasonable length were all destroyed there would not be a tenth of the female moths born to produce the percentage of high built nests that now exist.

The Tussock Moths (Orgyia leucostigma and O. antiqua) now and then appear in rather large numbers in their caterpillar form, but they are so easily kept in control by a little ordinary care in removing the egg masses that they hardly deserve mention. Their parasites keep them well in check.

It is several years since we have been bothered with the Tent caterpillars of the orchard and the forest (Clisiocampa americana and C. sylvatica) and the familiar rings of eggs seem to be very few and far between this winter. The parasites have evidently at present the upper hand, but this will not last, unfortunately, and the fruit-grower dare not neglect his trees when the little webs begin to show in the early Spring days. Before the buds have properly begun to open, the baby caterpillars are waiting for them. When the nests are small you can generally take the entire brood of caterpilars within it, whereas a little later on some are often in distant parts of the tree, besides which they are not easy to see when the foliage begins to get heavy.

The caterpillars of the Morning Cloak Butterfly (Vanessa antiopa) are sometimes very common during the Summer, preferring willow but also very fond of elm. They are about two inches long, black, with a row of large orange-red spots along the back and covered with black spines. They feed gregariously and work upon a branch till they strip it, and often make a tree look very ugly, but seldom if ever do any permanent injury.

In our gardens the most provoking pest is the White Butterfly (Pieris rapæ) which delights in destroying nasturtiums, and leaving nothing but stalk, often appearing to do the work of destruction in a single day. The well-known smooth, green caterpillars with a pale yellow stripe on the back lie outstretched on the leaves and seem to lazy to do anything but eat. Hellebore keeps them in check, but unfortunately there are many broods in a season, and the butterflies can be seen laying eggs on the plant during their entire growing season, so that one must be eternally vigilant.

Aphides or Plant Lice were, I think, especially abundant in 1908, and between these and the hot, dry summer the sweet peas suffered.

Cut-worms were numerous and their work of destruction of our choicest flowers is often blamed on other insects as they work almost wholly at night and conceal themselves so carefully during daylight.

There are a number of species of caterpillars which feed in the stems and roots of plants, making the leaves turn yellow, such as the Meadow Rue, the columbines and irises. It seems impossible to get a remedy for these insects, but so far as I can see they do little permanent injury to the plants, and seem to injure one year's growth of roots merely to make room for the next growth.

THREE IMPORTANT FUNGOUS DISEASES OF THE ORCHARD.

William Lochhead, Macdonald College.

It is conceded by all fruit-growers that Apple Scab, Black Knot and Brown Rot do a great amount of injury to fruit and fruit-trees. Every year these fungous diseases are more or less prevalent in all parts of the country. The susceptibility of the Fameuse to the Apple Scab is the one great drawback to the highest commercial development of this queen of apples. Moreover, the Fruit Marks Act makes it impossible to send abroad as first-class fruit any that is affected by the Scab. And as a result, more attention has been given of late to the prevention of this disease by applications of Bordeaux Mixture.

I. **Apple Scab.** (Venturia pomi (Fr.) Wint.)

This fungus was, until very recent years, known only in its summer stage, as **Fusicladium dendriticum** (Fckl.), an "imperfect fungus." It makes its appearance in the Spring on the young leaves as velvety-olive patches of mildew. These infected areas continue to enlarge until they cover the larger portion of the surface of the leaves in cases of severe attack. The leaves then become shrivelled and brown and soon fall off. When these diseased patches are examined closely they are seen to be covered with short erect stalks bearing spores, which are readily separated and blown away. By means of these summer spores the disease spreads rapidly from tree to tree, and from leaf to fruit. On the fruit the fungus works under the outer skin, producing pustules which break out on the surface. Sometimes the number of pustules or scabs is very large, especially around the blossom end of the apple, so that the fruit is rendered worthless. (Fig. 15).

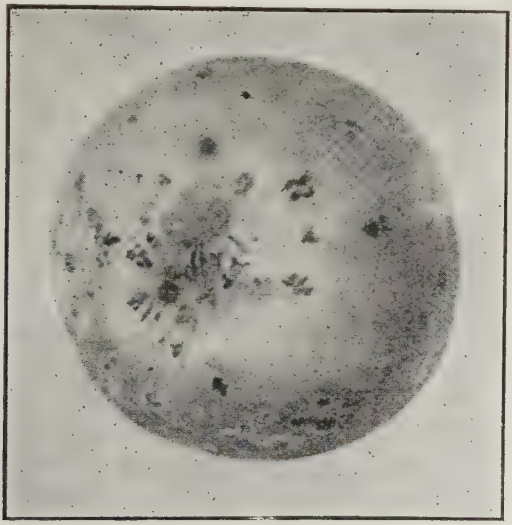


FIG. 15—"Scab" spots on an apple.

The winter form of the fungus is found in the infected fallen leaves that have lain on the ground all winter. They appear as minute black bodies buried in the leaf tissues, and contain a number of sacs each enclosing eight spores. These spores reach maturity in the Spring, escape from the sac, and are blown to the young leaves which soon show the characteristic patches already described. (Fig. 16).

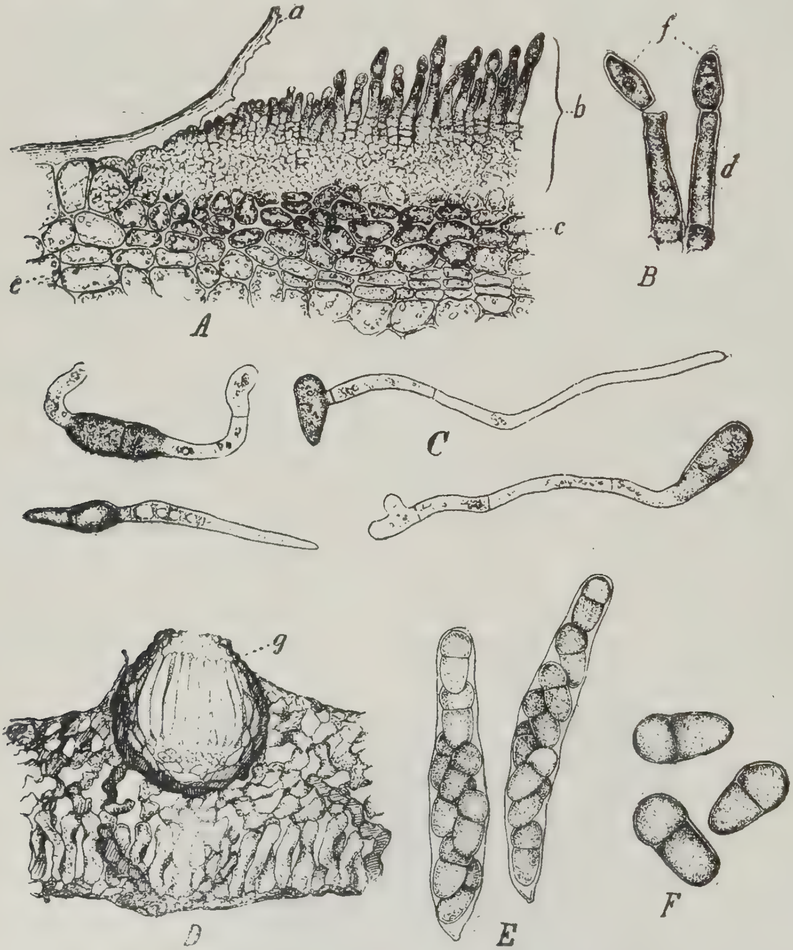


FIG. 16—Microscopic structure of the scab fungus. A, portion of a section through a scab spot on an apple showing the fungus; (b) spreading under and lifting the cuticle, a ; c, partly disorganized cells of the apple ; e, healthy cells of the apple. B, two spore-bearing stalks (conidiophores) giving rise to summer spores (conidia) f ; C, spores germinating ; D, portion of section through an affected leaf of apple which has lain on the ground over winter and has given rise to the winter spore stage of the disease ; g, spore case (perithecium) containing a bundle of spore sacs (asci) ; E, two spores sacs (asci), more highly magnified, each containing 8, two-celled winter spores three of which are shown at F. All highly magnified. (Longyear.)

Unlike some other fungous diseases the Apple Scab fungus thrives best during cool moist weather. If such a condition prevails in late spring and early summer the disease will be quite prevalent. Moreover, when trees are crowded together closely so that air and light find difficulty of access, the fungus will thrive better than when the trees are properly spaced and pruned.

Treatment.

(1) It is important that the dead leaves should be raked up and burned before the winter spores, which they harbor, can escape and infect the new leaves.

(2) A thorough spraying with copper sulphate solution or Bordeaux should be given **just as the leaf buds are opening** to prevent infection of the leaves by the winter spores. Spray again with Bordeaux just **before** blossoming, again **after** blossoming, and afterwards at intervals of ten days or two weeks, especially if the season is a moist one. Experience has convinced many fruit-growers that it pays to spray as often as five or six times.

In actual practice it is advisable to add Paris green to the Bordeaux to control the codling worm and other biting insects that are usually found in orchards.

2. **Black Knot** (Plowrightia morbosa (Schw.) Sacc.). Fig. 17).

This disease is a very common one on both the cultivated and wild cherries and plums, and is readily recognized by the black wart-like growths on the branches. The fungus enters the limb through a wound to which a spore has been carried. The spore finds there conditions suitable for germination and soon develops a mycelium which stimulates the tissues to abnormal growth. At first the swellings or knots are cushion-like and are of a dark olive colour. On close examination these enlargements will be seen to be covered with summer spores borne on short erect stalks. These spores are readily blown away and can infect other branches whenever a wound presents itself for infection. Later in the year the knot turns black and hard. Winter spores form in sacs borne in cavities on the surface, and these mature late in winter. In early spring they escape and are capable of infecting new branches the same season. The mycelium of the fungus is able to winter over in the branch, and to keep on growing year after year and spreading to new branches.

Treatment.

(1) Since the mycelium is perennial within the diseased limb, careful and persistent pruning of the knots in winter or early spring will prevent the knots from producing new spores, and also from spreading

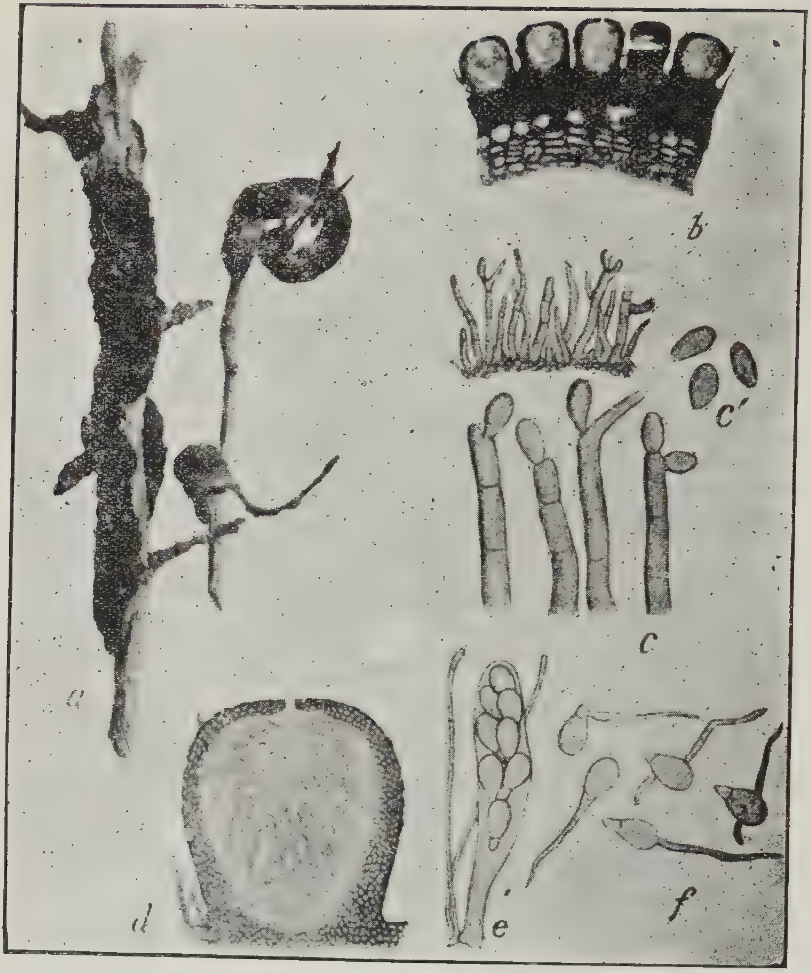


FIG. 17—Black Knot fungus. a, mature knots on plum branchss; b, magnified section of a knot showing the spore cases (perithecia); c, spore stalks (conidiophores) which grow on the surface of the knots when young and give rise to summer spores (conidia), c; d, section of a winter spore case (perithecium) more highly magnified, showing numerous contained spore sacs (asci), one of which is shown very highly magnified at e; f, several of the two-celled winter spores germinating in water. (Longyear.)

into unaffected limbs. The knots removed by pruning should be burned and not thrown into a pile in a fence corner.

(2) It is also necessary to spray with Bordeaux one or twice during the season to prevent the germination of spores that may be carried from trees affected with the disease.

(3) Co-operation among fruit-growers for the purpose of destroying all knots, both on the wild and cultivated cherry and plum trees of the locality, will very materially assist in eradicating the disease.

3. **Brown Rot** (Sclerotinia fructigena (Kze. & Schm.) Norton.)

This fungous disease is responsible for the destruction of large numbers of plums, cherries and peaches. It is also found on early apples, but in this case the loss is usually not great. Plums and cherries affected with the Brown Rot soon begin to show soft areas which take on a brown discoloration. Ashy brown tufts of spore-bearing threads break through the skin of the fruit and liberate large numbers of summer spores which are arranged in branching chains (Fig. 18). In a few weeks the whole fruit softens, and eventually through the loss of water it gradually hardens and becomes a "mummy." In this condition the diseased fruit often hangs on the tree all winter.

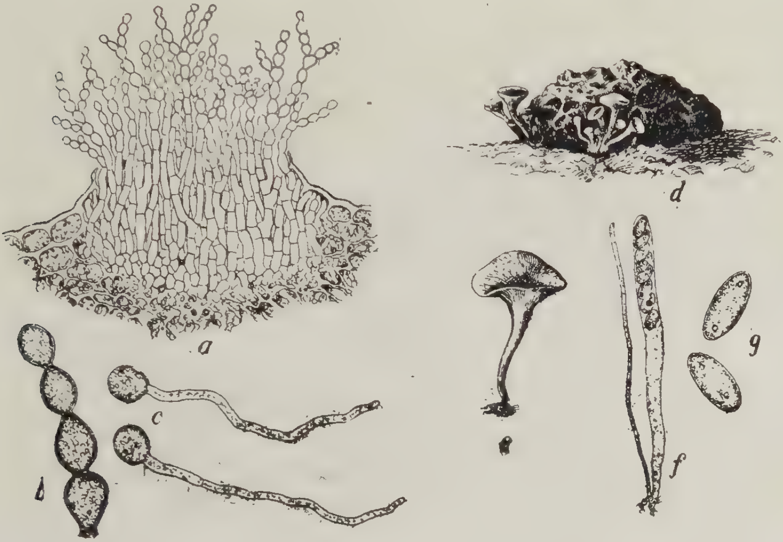


FIG. 18—a, Section through a diseased plum showing a spore pustule bursting through the skin of fruit and producing chains of spores (conidia); b, part of a spore-chain; c, spores germinating in a drop of water (all highly magnified); d, an old mummy plum which has lain on the ground over winter giving rise to small flesby outgrowths (ascophores) in form like little wine glasses; e, one of these outgrowths somewhat enlarged; f, some of the slender spore sacs (asci) which line the cup like part of the flesby organs shown at d, e; g, mature spores from a spore sac, highly magnified. (Longyear.)

In spring when rains soften these mummies the mycelium within them revives and may produce more summer spores, which serve to infect the new fruit.

But infection may also occur from winter spores borne in sacs lining the surface of little flask-shaped outgrowths of mummies that have fallen and lain partially buried all winter. (Fig. 19). These winter spores mature in early summer, are set free from the sacs, and may infect the new fruit.

Sometimes Brown Rot fungus may gain entrance to the stem through a wound. In such cases, a diseased condition of the tissues ensues with the formation of a flow of gum which collects on the bark at the point of attack. This gumming occurs quite frequently on peach trees, and is similar to that produced by certain bark beetles.

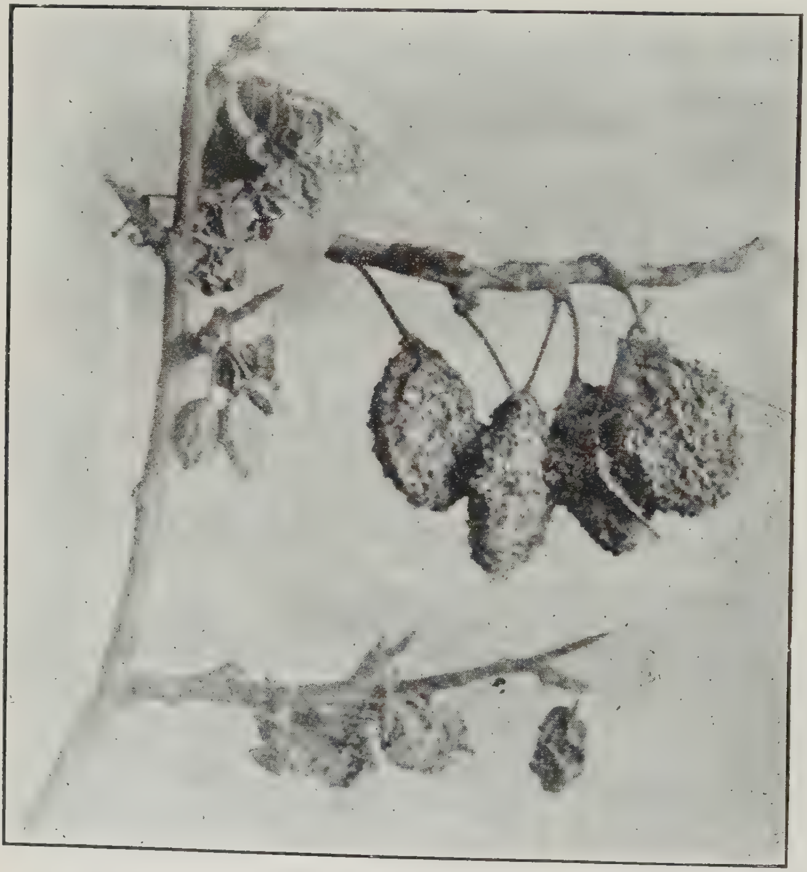


FIG 19—Plums affected with brown rot found on trees in February, showing mummified condition. These plums still retain the ability to give off spores (conidia).

Treatment.

(1) It is advisable to destroy both the mummy plums that remain on the trees and those that fall to the ground so as to prevent the liberation of spores in the late spring.

(2) Thorough spraying with Bordeaux—(a) Just before the buds open; (b) just after blossoming; (c) and again at an interval of two weeks.

(3) Thinning of the fruit will prevent the rapid spread of the disease that occurs when fruits are in contact.

Brown Rot is a difficult disease to control, but it has been observed over and over again that those orchards that are sprayed with Bordeaux year after year are least affected with the disease.

POTATO DISEASES.

Douglas Weir, Macdonald College.

The potato crop of the past few years has been very unsatisfactory in Canada. The mischief caused by certain fungi and bacterial diseases seems to have increased, supplementing the already extensive ravages of the Colorado potato beetle. In Ontario during the season of 1906, the losses caused by diseases of this kind were so marked that it was impossible, in certain districts, to supply even the local markets, and potatoes had to be imported.

It may be useful to describe briefly some of the pathological aspects of these sources of injury to the potato, as the gravity of the evil sufficiently warrants every rational effort to mitigate it. We subjoin some notes on the early blight, the late blight, the potato scab, and the fungus and bacterial wet rots.

The Early Blight.

The potato leaf blight or early blight (Alternaria solani) was especially widespread and destructive. The disease attacked the leaves and green shoots of the plant, spreading rapidly and checking the growth of the tubers. The first indication of the disease was the appearance of brownish spots on the leaves about the time of blossoming, resulting in the characteristic curling and withering of these parts, in the destruction of the stem, and later, of the young tubers themselves.

It will be readily appreciated that an early destruction of the leaves must of necessity result in greatly diminishing the size of the tubers, for in the absence of leaves the highly elaborated plant food so essential to growth cannot be obtained.

Although the early blight is most frequently observed about the time of blossoming, it may also attack plants at an earlier stage, and not uncommonly has been observed on plants scarcely six inches high.

The common flea-beetle is believed to distribute this fungus extensively. It establishes excellent places for infection, by burrowing holes in the leaves and may even carry the spores along with it from diseased plants. The remedial measures are the same as suggested for Late Blight.

The Late Blight.

The Late Blight or Fungus Rot (Phytophthora infestans) has caused even greater loss than the Early Blight. Moist warm weather is especially favorable to its development, and under such conditions it spreads with singular rapidity. During the warm humid weather of July, 1906, which prevailed in many sections, the disease spread so suddenly that fields, appearing healthy and green one day, became withered and blackened the next.

The infected areas show, in the early stages, a well defined limiting line, but during such weather as just described, these soon extend over the whole leaf, becoming soft and emitting a very unpleasant odour.

General Morphology. If we examine the brownish spots originating on the under side of the leaves with a hand-lens, we find them composed of many delicate white branching threads, which protrude through the **Stomata** or breathing pores, and produce (conidia) spores. These spores are somewhat egg-shaped, colourless and are blown about by the wind and washed by the rain, until they fall on neighbouring leaves or are washed through the soil to the tubers. After falling on a moist leaf or being washed by rain to a young tuber, the spore gives rise to a number of minute swimming spores, (zoospores) which move actively about. These eventually settle down and emit slender germ-tubes which may enter the leaf through a stoma or directly penetrate the epidermis. Once within the plant, the fungus develops rapidly and sends its branching root-threads (mycelium) in every direction.

Many experiments are to-day being carried on by plant pathologists in the endeavor to obtain accurate data as to the life-cycle of the Late Blight, so that remedial measures may be taken when they are most applicable and effective. Prof. George Massee describes one of special

An Experiment described.

economic interest which was conducted at Kew. In this experiment three potatoes showing the brownish stains so characteristic of the Phytophthora Blight, were cut in half and planted in pots. Three of the pots were placed in a hot-house at a temperature of about 70° F., where the humidity occasionally reached saturation point, and the remaining three put in a room having no artificial heat and where the air was kept as dry as possible. Equal quantities of water were supplied in each case. The results were, in brief, as follows:

Discussion of results.

The plants grown under the warm moist conditions developed rapidly, but the fungus also developed, appearing when the plants were six weeks old and by the end of the succeeding two weeks the three plants were completely blackened and killed. On the other hand, those grown under dry conditions did not develop as rapidly as the others, but were apparently free from the fungus; when, however, they were removed to the warm moist surroundings the dormant mycelium developed so exceptionally, that within a fortnight these also were killed.

Conclusions arrived at.

From this experiment we may conclude that epidemics of potato blight are influenced largely by weather conditions, and the potato grower is advised to take as much care in selecting his seed potatoes, by obtaining them from districts free from blight, as he now commonly does in selecting his peas to insure freedom from the much dreaded pea-weevil.

It should also be remembered that infection by the Early and Late Blights is due, not only to the hybernating mycelium, but also to the spores produced on the leaves.

"Spraying to Prevent Rot."

Prof. L. R. Jones, of the State Agricultural College, Burlington Vt., has recently published the result of some interesting experiments with fungous rot (18th Report, Vermont Agr. Exp. Station), and as the climatic conditions of Vermont and Quebec are similar, his experiments may perhaps deserve our attention.

An Experiment.

Prof. Jones selected Delaware potatoes, which were planted in the early part of June in a heavy, moist, clay-loam. On August 2nd, the surface of the soil immediately under and surrounding the potato plants was sprayed with Bordeaux Mixture (copper sulphate 6 lbs., lime 4 lbs., water 40 gals.), care being taken to prevent the mixture falling on the foliage. Spraying was repeated on August 18th and up to this time no Phytophthora blight had been seen. Soon after the second spraying, however, the blight appeared and developed rapidly throughout the rows during September. A final spraying was given on August 28th, so that after spraying had been concluded, one-half the plants had been treated three times and the other half remained untreated for comparison. As September was a wet warm month, the blight developed profusely and the results of the experiment were consequently well marked. The following are the yields recorded in pounds:—

Soil Sprayed		Soil Unsprayed	
Sound Tubers	Rotten Tubers	Sound Tubers	Rotten Tubers
60.2	12.5	13.5	57.9

Discussion of results.

Prof. Jones writes:—"The results of the two trials are in general agreement in showing, not only that the disease passes from leaf to tuber, but that the main channel at least is through the soil rather than through the stem." The Professor, in concluding, informs us that the rot appeared in spite of the spraying and in view of this fact all the infection cannot be explained by the sporulation from the leaves or the passing of the fungus threads through the stem; but undoubtedly some spread occurs from tuber to tuber in the soil. Prof. Jones fails, however, to state whether the potato sets used in his experiments were free from blight when planted. Some of the questions that would naturally present themselves to the potato grower in this connection are:—

(a) Were the potato sets experimented with, free from Phytophthora blight?

(b) Were they gathered at random?

(c) Did they actually contain the hybernating mycelium and show the characteristic markings?

If the sets were free from the fungus when planted, we would naturally attribute the consequent infection to spores, blown from diseased plants, affecting an entrance through tuber or leaf, or to spores from decayed tubers or stems already in the ground.

If the sets were gathered at random, some would undoubtedly be infected. If, however, they were known to actually contain the dormant hybernating mycelium of the Phytophthora blight at the time of planting, we would have a clearer basis to work on and the results of the experiment would be more comprehensive. At all events Prof. Jones proves that after the plant is infected the further spread of the fungus is largely by the leaf spores (conidia) falling to the ground and being carried by rains to the tubers as previously mentioned.

An Experiment. Another experiment conducted under the direction of Prof. Jones, with a view to ascertaining whether the fungus spreads from tuber to tuber in the soil, proved this to be the case. Prof. Jones states that—"upon digging at different times and places during the last half of the month (Sept. 1905) the fungus (Phytophthora) was frequently found growing in tufts from the surface of decaying tubers; and such tufts were always richly covered with spores. Moreover, the soil conditions were favorable for their development and for further infection of tubers, as was shown by the fact that some of these spores were found in process of germination, i.e., zoospore formation (swimming spores), moreover, the fungus threads or mycelium were found ramifying through the interstices of the soil for one-fourth to one-half of an inch from the surface of such decaying tubers and there sporulating abundantly." These facts would seem to prove conclusively that the spread of the fungus from tuber to tuber actually occurs.

General results obtained. Summarizing the results obtained both by Professors Massee and Jones, we note that there are several ways whereby this Phytophthora blight is disseminated.

(1) Infection of tubers by means of spores, the latter being conveyed by rains, etc., to the tubers.

(2) Infection of tubers by spores from adjacent decaying tubers, particularly in moist soil.

(3) Infection of tubers of same plant, by **mycelium** extending from diseased tubers through the stem into adjacent tubers.

(4) Infection of the plant by **mycelium**, through planting diseased sets, in which case the fungus threads develop with the plant, sporulating on the leaves and under favorable conditions, the tubers.

(5) Infection of host plant, by means of spores, blown from neighbouring diseased plants, obtaining entrance directly or through leaf stoma.

Considering these various ways of infection, it is clear that the long practised method of spraying with Bordeaux Mixture should be persistently continued, so that the blight may be controlled in its preliminary stages and the fungus spores either destroyed or kept well in control. If these spores infect the tubers and the infected sets are planted the following spring, the fungus would develop with the plant, maturing even more rapidly and producing sufficient spores to infect the whole neighbourhood.

The Potato Scab.

The term Scab refers to the irregular rough areas on the tubers, and is caused by the fungus **Oospora scabies.** This fungus was widespread throughout the State of Maine during 1905-06, but is successfully controlled by treating the tubers before planting, with either corrosive sublimate* or formalin. As this precaution is commonly in vogue there is no good reason why this disease should prove destructive. Quebec was comparatively free from this fungus.

The Fungus Wet Rot.

There are several forms of Wet Rot, some being due to fungi, and others to bacteria. Of the parasitic fungus forms, the one which seems to have caused the most recent damage is **Rhizoctonia solani.**

Morphology of Rhizoctonia.

This fungus is found parasitic upon the potato tubers and occasionally gives rise to a series of adventitious tubers upon the stem. It may attack the plant at or beneath the surface of the ground, and by girdling the stem prevent the development of tubers. In severe cases a Wet Rot occurs, resulting in the death of the plant; but, in milder forms it simply girdles the stem.

Dr. Nelson (Bulletin No. 71 of the Wyoming Experimental Station) informs us that this disease was particularly destructive in the middle west and in the Rocky Mountain States during the past few years, and as reports of its occurrence have been received from Ontario (Huron Co.) and New Brunswick, it is quite possible that it may be far more widely prevalent than heretofore supposed.

Prof. F. M. Rolfe, of the Colorado Exp. Station, after exhaustive investigation, observes that there are three characteristic stages of the disease. These he designates: **The Rhizoctonia stage,** where only the fungus threads are present; **The Corticium stage,** where minute spores borne upon short lateral threads appear and **The Sclerotium stage,** where compact masses of fungus threads are observed on tubers and stem. The latter is the hybernating stage of the fungus over unfavorable weather conditions and it is in this form that the disease is carried over winter, the sclerotia germinating the following spring.

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* 2 oz corrosive sublimate dissolved in 2 gals. hot water, then make up to 14 gals. Leave seed potatoes for 1½ hrs. Allow potatoes to dry before cutting or planting

FORMALIN ¼ pt. to 15 gals. water, soak potatoes 2 hrs., then dry and cut.

It seems probable that this disease in effecting an entrance to and injuring the potato tuber, prepares a condition suitable to the growth of bacteria which enter the tuber and give rise to a bacterial Wet Rot. No specified instance can be given to prove, in this case, that there is any special symbiotic relationship between the fungi and bacteria; at the same time, it would appear that the tubers, ramified with fungus threads, are more susceptible to bacteria. For this additional reason we urge that spraying be resorted to early in the season, in order to control these fungus diseases and help to minimize the conditions favorable to bacteria.

The Bacterial Wet Rot.

Another Wet Rot which caused considerable loss in the Province of Quebec and was also reported from other parts of Canada, is the Bacterial Rot, caused by **Bacillus solanisaprus.**

According to Prof. F. C. Harrison, of the Macdonald College, Ste. Anne de Bellevue (Abdruck aus dem Centralblatt fur Bakteriologie, XVII Bond. 1906), this rot was observed as being destructive in several districts, as far back as 1904. Since then it appears to be increasing rather than decreasing, and suspected specimens received from the Provinces of British Columbia, Manitoba, Ontario and New Brunswick, proved, upon examination, to be due to this organism. The leaves of the potato plant, at first, become yellowish and droop; later, black areas appear on the stems, extending, until the leaves, or it may be the whole plant, topples over and dies. The tubers have a bruised appearance and the flesh is soft; finally the soft areas become black and emit an offensive odour.

Insects disseminate the disease by carrying the spores about on their bodies and flying from diseased plants to healthy ones, they inoculate the latter in eating the foliage.

The remedial measures consist in collecting and destroying infected tubers, selecting healthy seed potatoes, storing at a temperature below 45° F., and controlling the fungus diseases of the potato.

Losses and Remedies.

When we endeavour to compute the loss to the country caused by insects and fungi in the potato field, we are confronted with most astounding facts.

The actual marketable crop for Quebec and Ontario in recent years amounts to about 30,000,000 bushels per annum. In 1901, a good year, the yield was 37,000,000 bushels; but later years have been less favorable. the late Dr. Fletcher, in his report for 1904 (Experimental Farms, 1904, p. 223), says:—" In Ontario there was a large yield, but considerable rot appeared, especially on heavy soil or on low land; the extent of the loss is variously estimated at from 20 to 50 per cent.," or in money, to the extent of something over seven millions of dollars.

Prof. Lochhead of the Macdonald College conservatively estimates the loss from the Colorado beetle alone at 10%. An absolutely accurate appraisement of loss is, of course, scarcely possible. But it is no rash deduction that but for the scourges we have been describing the crop of 30,000,000 to 37,000,000 bushels might easily have reached 70,000,000 bushels.

Anyone can easily compute the actual loss in dollars to the country, and form a fair estimate of the probable loss from year to year resulting from the existence of these most virulent diseases in so necessary an article of food. The matter is clearly one of vast economic importance and demands the most earnest and intelligent action on the part of all concerned; upon the grower the responsibility probably lies heaviest, and upon him we would earnestly urge the adoption of the following measures:—

(1) The selection of seed from fields unaffected by diseases.

(2) The collection and destruction by fire of all infected tubers and plants.

(3) Regular, thorough and early spraying of the Bordeaux or Bordeaux-Paris green mixtures.

The importance of this whole subject and the necessity of conducting further investigation by scientific methods, have led the Department of Biology in the Macdonald College to decide upon a thorough examination of these causes and remedies of potato infection.

The results of these special researches will be duly published and circulated as widely as possible.

THE BEST FUNGICIDES.

W. Lochhead, Macdonald College.

Bordeaux Mixture.

The fungicide that is most commonly used in orchard and garden practice for the control of fungous diseases is the Bordeaux Mixture. This is usually made according to the following formula and directions:

Copper sulphate (blue stone)	4 pounds.
Fresh stone lime	4 pounds.
Water	40 gallons.

(1) Make a stock solution of blue stone 40 pounds in warm water in a barrel, and add water to make up to 40 gallons. Every gallon of this solution in first barrel contains one pound of bluestone.

(2) Into a second barrel put 40 pounds of fresh stone lime, and add with stirring small quantities of water to slake it. When fully slaked make up to 40 gallons by adding water. Every gallon of milk of lime in this second barrel contains one pound of lime.

To prepare the Bordeaux, empty four gallons of blue stone solution into the spray tank or barrel, which already should have 25 or 30 gallons of water in it; stir the milk of lime thoroughly and empty four gallons of it through the strainer into the spray barrel with constant stirring; then add water to make up to 40 gallons.

Any one of several arsenical compounds may be used along with the Bordeaux to form a combination insecticide and fungicide. The following are among the best:

(a) Paris green. Add four to six ounces to 40 gallons of Bordeaux.

(b) Arsenite of soda. Boil together for 15 minutes one pound white arsenic, four pounds sal soda, and two gallons water, until a clear solution is obtained. Add one to one and one-half quarts to 40 gallons of Bordeaux.

(c) Arsenite of lime. Boil together for 45 minutes one pound arsenic, two pounds fresh lime, and one gallon of water. Add one quart of this solution to 40 gallons of Bordeaux.

(d) Arsenate of lead. Put four ounces of arsenate of soda in two quarts of water in a wooden pail and eleven ounces acetate of lead in two quarts of water in another pail. When dissolved mix together and add to 40 gallons of Bordeaux.

(3) Never mix the concentrated stock solution together. If the milk of lime and blue stone are mixed in the concentrated form, just as they are taken from the stock solution, a precipitate of a flaky nature will soon settle out, and either fall to the bottom or clog the nozzle.

(4) Test the Bordeaux to find out whether sufficient milk of lime has been added. This is easily done by means of the ferrocyanide test. A saturated solution of this substance can be purchased at any druggist's for a few cents. In testing, place some of the Bordeaux, which has been thoroughly stirred, into a saucer, and add a few drops of the ferrocyanide. If sufficient lime has been used, no discoloration will appear, but if insufficient, a deep dark brown color will be produced.

(5) Always strain the milk of lime to prevent gritty particles from clogging the nozzles.

(6) Use a fine nozzle; do not soak or drench the plants.

(7) The stock solution will keep, bu the Bordeaux mixture becomes useless after standing for two or three days.

Resin Bordeaux Mixture.

Resin Bordeaux Mixture is sometimes used when ordinary Bordeaux will not adhere to smooth leaves. It has been used successfully against Asparagus rust. It is made as follows:

Pulverized resin	5 pounds.
Concentrated lye	1 pound.
Fish oil	1 pint.
Water	5 gallons.

Place the oil, resin, and one gallon hot water in an iron kettle and heat till resin softens, add the lye and stir thoroughly; then add four gallons hot water and boil till a little will mix with cold water and give a clear, amber-colored liquid. Add water to make up five gallons. Keep this as stock solution. For resin-Bordeaux, add ten gallons water to two gallons of stock solution, then mix this with 40 gallons Bordeaux.

This mixture is very adhesive to smooth leaves; has been used successfully against asparagus rust.

Weak Bordeaux Mixture.

The formula given above is too strong for green-house plants, where as a rule, the foliage is tender and succulent. A weaker solution can, however, be used without danger.

Copper sulphate	2½ pounds.
Fresh stone lime	4 pounds.
Water	40 gallons.

Copper Sulphate Solution.

When there is no danger of injuring leaves as during the dormant period of the plant when the foliage is off, Copper Sulphate is often used instead of Bordeaux, as it is more readily prepared and is just as effective in destroying fungous spores and threads.

Copper sulphate	2½ pounds.
Water	40 gallons.

Ammonia Copper Carbonate.

Ammonia Copper Carbonate is used when there is danger of disfiguring the maturing fruit with the application of Bordeaux. It is made according to the following formula:—

Copper carbonate	5 ounces.
Strong ammonia, sufficient to dissolve the copper carbonate, usually about	3 pints.
Water	40 gallons.

Mix the copper carbonate into a paste with a little water, add the ammonia, and when the copper carbonate is completely dissolved, pour the deep blue solution into the water.

Potassium Sulphide.

Potassium Sulphide or Liver of Sulphur is commonly used to control mildews, and especially gooseberry mildew. Four ounces are dissolved in eight gallons of water. It is too expensive to use on a large scale.

Sulphur.

Flowers of Sulphur scattered over foliage are beneficial in preventing mildews.

Formalin.

Formalin (40 per cent. formaldehyde) is one of the best substances for the prevention of potato scab and smut. For potato scab, immerse the potatoes for two hours in a solution made by adding 4 ounces in 8 gallons of water. For oat smut and stinking smut of wheat sprinkle the seed grain with a solution made by adding 1 lb. formalin in 32 gallons of water.

INDIAN CORN.

Rev. Thomas W. Fyles, D.C.L.

A well ordered field of Indian Corn is a sight to gladden the owner's heart and to win the admiration of the passers-by. The tall stems towering overhead, each surmounted by its graceful panicle of male blossoms—the long sword-like leaves—the pale sea-green tassels of the female blossoms, bursting from their cases in graceful curves, present a charming picture.

It is customary to plant pumpkin seeds here and there among the corn; and the plants that spring from these are in striking contrast to those of the corn: they have long trailing stems, ample leaves, and blossoms like golden chalices which attract the roving bees.

Here, then, we have two monœcious plants, one wind pollinated, the other insect pollinated.

Notice the economy of Nature: In the corn there is an absence of bright colours of nectar and perfume. These are not necessary to the fertilization of the plants. On the other hand, the pumpkin has gaily coloured blossoms, supplied with sweets which draw the insects to them; and the marauders convey the pollen on their hairy coats, from male blossoms to female, and from plant to plant.

One of the finest fields of corn I ever saw in the Province of Quebec was on the farm of the late Lt.-Col. Calvin Hall, of East Farnham. The plants were so tall, so even, so regular that they resembled a regiment of the Guards on parade. There seemed to be no dwarfed and barren plants among them.

The first step towards success in corn-raising is the choice of seed. This should be made in the beginning of October. The farmer, carrying a basket or sack, should pass along the rows of corn, stripping down the promising ears of the finest plants, and breaking off and casting into their receptacle the ears suitable for his purpose. These should be hung in the sunshine for a few days to harden, and then transferred to the usual chamber over the kitchen in the extension or L of the farm-house.

When seed-time arrives the farmer should reject the grain from the tips and buts of the ears; and twist off the remainder into a tub. Upon this chosen seed a little tar should be poured, and well stirred in, till every grain is tarred. Then some wood ashes should be stirred in likewise, to prevent the grain from clogging. The seed will then be ready for the planting. The tar will prevent the crows from disturbing the newly-planted grain.

The preparation of the soil for a corn crop is very important.

In the fall, a field of clover should be well ploughed in; and in the spring about ten tons of hog manure to the acre should be ploughed in also. The field should then be well harrowed—first with a disk-harrow, and then with a smoothing harrow. The land cannot be worked too much for corn. Where chemicals are thought necessary, the under-mentioned are recommended:—

130	lbs.	muriate of potash	per	acre.	Value	$2.60	per	100	lbs.
400	"	acid phosphate	"	"	"	1.00	"	"	"
100	"	nitrate of soda	"	"	"	2.00	"	"	"

The time of planting corn in the Province of Quebec is from May 20th to June 1st—according to the season. Five or six grains should be planted to the hill; and the hills should be 3 ft. 6 in. apart every way.

A critical time for the corn is when the shoots are three or four inches high, for then it is open to the attacks of the cut-worms.

The history of the cut-worm is this:—They are the larvæ or caterpillars of certain moths belonging to the sub-order, **Noctuina** or **Night-flying** Moths. These moths appear in June, July and August. They are of sober colouring—brown, drab and grey are their prevailing tints. They lay their eggs at a time when vegetation is abundant, and in the thick herbage the ravages of the young larvæ are not noticed. These larvæ attain about two-thirds of their growth before the cold weather obliges them to seek suitable quarters for hibernation. In the spring they come forth from their winter retreats, active and voracious. The field of young corn is to such exceedingly attractive. The mode of procedure of a larva is this:—It travels over the surface till it comes to a young plant, it burrows to the roots of this; then ascends and nips off the plant near the ground; it drags the severed plant into its hole, and feeds on it at its leisure.

Some of the worst of the cut-worms are:—

The Glassy Cut-worm.—This is shining pale green in colour, and has a red head and a brown plate or scale on the second segment. It is the caterpillar of **Hadena devastatrix.**

The Greasy Cut-Worm is the caterpillar of **Hadena Ypsilon.**

The Striped Cut-worm is that of **Agrotis tesselata.**

When the cut-worms begin to work, the farmer, taking a spud or garden trowel, should pass along his rows of corn and wherever he finds a damaged plant should dig at the root of it, where he very certainly will find the spoiler, which he can deal with as his inclination prompts.

The young plants should be earthed up as soon as possible, for the cut-worms cannot ascend a mound of crumbling earth.

Another but less common insect enemy to the corn is the **Spindle Worm.** This is the caterpillar of the moth **Achatodes Zeæ.** It is of a greenish white dotted with black. It bites its way into the plant, and bores to the spindle, and does much harm. The knife is necessary to bring it to the light. The Spindle-worm moth is of a brick-red colour, and has a patch of clay-yellow on each fore-wing.

Diligent care should be exercised to guard the corn from the spread of **Smut.** Whenever a smutted ear is found, it should be cut off immediately and burned.

In the Eastern Townships the average yield of corn is 150 bushels of ears to the acre, but 200 bushels per acre have been raised. The favorite variety for domestic use is the eight-rowed flint variety, but twelve-rowed corn is also much grown. Home-grown corn meal is worth $1.60 per 100 lbs. Western corn meal is worth $1.45 per 100 lbs.
I have alluded to several dangers to the growing corn; there are dangers to it that no human skill can avert. We do well to pray,—

"From lightning and tempest
Good Lord deliver us."

I have seen barns unroofed, huge trees toppled over by the wind like nine-pins by the ball of the player; I have measured hail-stones 1¾ inches in diameter; I have seen fields of corn so completely destroyed by the hail that only a stump here and there remained to tell that such things had been——the plants having been cut into fragments which had been blown away or beaten into the soil.

But such grievous disasters are happily unfrequent. As a general rule, seed-time and harvest fail not; and the husbandman receiveth the reward of his labors in the joyful ingathering, the merry "husking-bee," the Thanksgiving Service, the supply of his wants; and he is or ought to be ready to exclaim:—

"All good things around us
Are sent from Heaven above,
Then thank the Lord, O thank the Lord
For all His love."

SOME FUNGOUS DISEASES OF THE GARDEN.

W. Lochhead, Macdonald College.

The Orange Rust of Raspberries and Blackberries.

(Cæoma nitens, Puccinia Peckiana, Gymnoconia interstitialis.)

This disease is more or less prevalent wherever Rubus fruits are grown. It forms orange-colored pustules of blister-like outbreaks on the under surface of the leaves, thus tending to prevent the formation of plant food. Occasionally in severe cases the stems are also attacked. The Orange-rust stage, so conspicuous between May and July, is but one of the stages in the life-cycle of this rust fungus. The other stages are also found on the same host.

In the early spring, small stalked gland-like bodies can be observed on both sides of the unfolding leaves. These are the **spermagonia** of this fungus, but their function and relationship to the **Orange-rust** stage are not known. The Orange-rust or Cæoma stage can usually be observed on the lower surface of the leaf in May and June. In July this is followed by the teleuto-stage, which produces the winter spores on the same plants but commonly on different leaves. (Fig. 20).

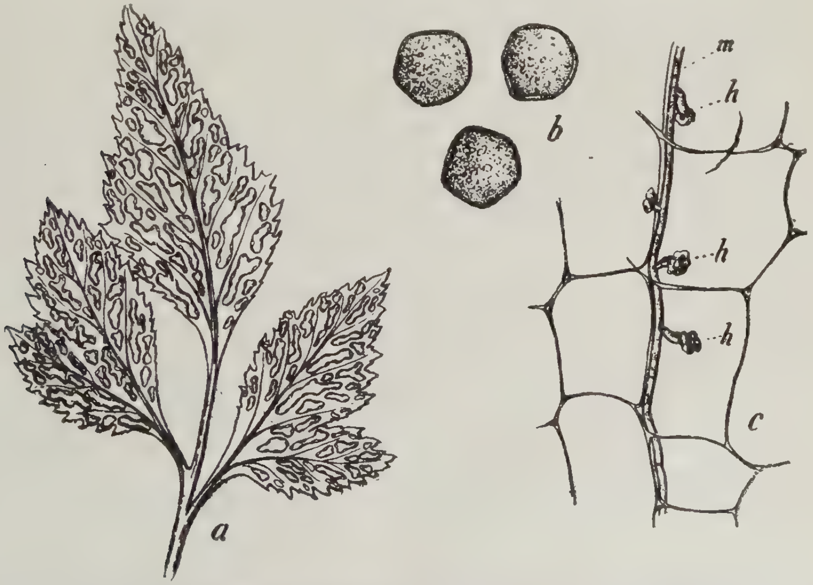


Fig. 20—a, A small leaf of raspberry showing blisters produced by the orange rust fungus; b, spores from a blister; c, sectional view of pith cells from diseased cane, showing a strand of mycelium m, passing between the cells and giving rise to sucker-like branches (haustoria), h, h, h, which enter the cells and absorb their nourishment. Magnified. (Longyear.)

The spores set free from the orange-rust cushions germinate on healthy leaves, their germ tubes gaining entrance within, by way of the breathing pores. From this mycelium within the leaf arises the teleuto-stage, known formerly as Puccinia Peckiana, but now as **Gymnoconia interstitialis.** These teleuto-spores are produced on the under surface of the leaves; they fall to the ground and germinate in the fall and early spring, entering the host through young underground shoots.

The most important economic feature in conection with this fungus is the perennial nature of the mycelium in infested plants. That of the Oronge-rust stage may be found in all parts of the plant, including the underground parts, so that shoots arising from these will be rusted year after year.

Treatment.

On account of the perennial nature of the mycelium it is very difficult to cope with this fungus. The best plan is to **dig up and destroy** infested plants as soon as they show symptoms of disease. No other plan will rid the plantation of orange-rust. Applications of Bordeaux as soon as the orange-rust spores appear will prevent the spread of the disease to **healthy** plants, but a plant once attacked seldom or never recovers. It gradually loses vitality, which condition is shown by the number of weak canes that arise from it.

Downy Mildew or Blight of the Melon.

(Plasmopara cubensis (B & C).

This disease of cucurbits has not been serious in recent years, but as it occurs periodically, any year may see it return and do much injury. It attacks all species of cucurbits, but is more commonly observed on musk melons and cucumbers than on squashes, pumpkins and water melons.

The disease first affects the leaves nearest the hill upon which it makes its appearance in July and August as large yellowish four-sided blotches. The affected leaves soon shrivel up and die, and the whole vine is seriously injured. The disease spreads rapidly in hot, moist weather, by means of summer spores which are produced in large numbers on the under side of affected leaves. The spores are purplish and are borne on branching stalks; they are readily carried by wind to healthy leaves. Each spore produces a large number of swimming spores, and in the presence of moisture each of these sends out a germ tube which enters the leaf and forms a mycelium.

Winter spores are not found, and it is not known how this fungus winters over.

Treatment.

As the disease spreads by means of the summer spores several thorough applications of Bordeaux will help to keep it in check. The first spraying should be given when the vines begin to run, and subsequent applications every two weeks thereafter, according to the nature of the season. It is advisable to spray the under side of the leaves, as the spores are produced on the lower surface.

Club-Root of Cabbage, Turnips, &c.

(Plasmodiophora brassicæ, Wor.)

This is a somewhat common disease of cabbage and other cruciferous plants. It forms distorted enlargements on the roots through the stimulation of the tissues. Eventually rotting sets in through the entrance of bacteria. Infected plants usually do not head out on account of lack of vitality, as they are unable to gather sufficient plant food from the soil.

The organism causing the disease is not a true fungus but a slime-mould. It produces spores but no mycelium of the nature of threads.

The cells comprising the enlargements on the roots are abnormally large, and become filled with a slimy mass of protoplasm called a **plasmodium,** the vegetative condition of the slime-mould. Eventually the plasmodium is converted into myriads of minute spores which are set free in the soil when decay sets in. It has been ascertained that the organism can enter the living cells of the roots of healthy cabbage and turnip plants even after a residence of two or three years in the soil. Even cruciferous weeds,, such as Shepherd's Purse, Mustard, etc., become infected, and therefore these plants should not be allowed to grow where cabbage, turnips, cauliflowers and radishes are grown.

Moreover, it has been shown that soil taken from an infected field to a new locality may carry infection with it, and that manure from stables where turnips with Club-root disease are fed to the stock will infect cruciferous crops.

Treatment.

This disease is a difficult one to treat successfully. (1) It is evident, however, that cabbages, turnips, &c., should not be set out in a field which has recently borne Club-rooted plants. A long rotation is advisable. Some growers claim that buckwheat grown in turnip land has a good effect in lessening infection by Club-root.

(2) Diseased plants should not be fed to cattle, nor should they be thrown on the manure heap, for the reason that such manure will easily infect crops.

(3) Lime spread over the soil at the rate of 75 bushels to the acre has been shown to be an effective preventive of Club-root.

THE BROWN-TAIL MOTH.

New Insect Enemy Threatening Ontario and Quebec.

By W. Lochhead, Macdonald College.

For ten years or more the caterpillars of the Brown-tail moth have been veritable scourges in the orchards and woodlands of some of the New England states. In spite of strenuous efforts to control their ravages they have continued to spread, so that it is probably only a question of time before this much-to-be-dreaded pest will make its appearance in Quebec and Ontario. It is already in Nova Scotia, and the authorities there are sparing no efforts to exterminate it at the outset. It has recently been found in New York State on importations of fruit seedlings from France, and it is understood that Mr. Arthur Gibson, acting entomologist at the Central Experimental Farm, Ottawa, recently found some wintering nests of the insect in Ontario on some shipments of stock from France.

It is evident, therefore, that the situation is critical, and that if the nurserymen and the government authorities are not extremely alert and careful the Brown-tail moth will find so permanent a lodgment in Canada that it will be impossible to expel it.

The life-story of this pest is as follows: The moths make their appearance in July in New England. They are pure white, with the exception of a brush of brown hairs at the end of the abdomen, hence the name the Brown-tail moth.

They are nocturnal, strong fliers, and are attracted to lights. The eggs are laid during July and August in masses on the under surface of leaves of orchard and woodland trees. Each brownish egg-mass contains about 300 eggs, and is covered with hairs. The caterpillars on hatching from the eggs feed in clusters on the upper side of the leaves, and soon skeletonize them. When young, the caterpillars are blackish, and covered with reddish brown hairs. When full grown they are about two inches long and of a reddish brown color. A broken white line runs along each side. Tubercles along the back and side bear both long and short brown hairs. There are two red dots near the end of the back, and several orange patches.

In autumn, the caterpillars which are about one-third grown, make their winter nests of leaves drawn together with silk. Within these

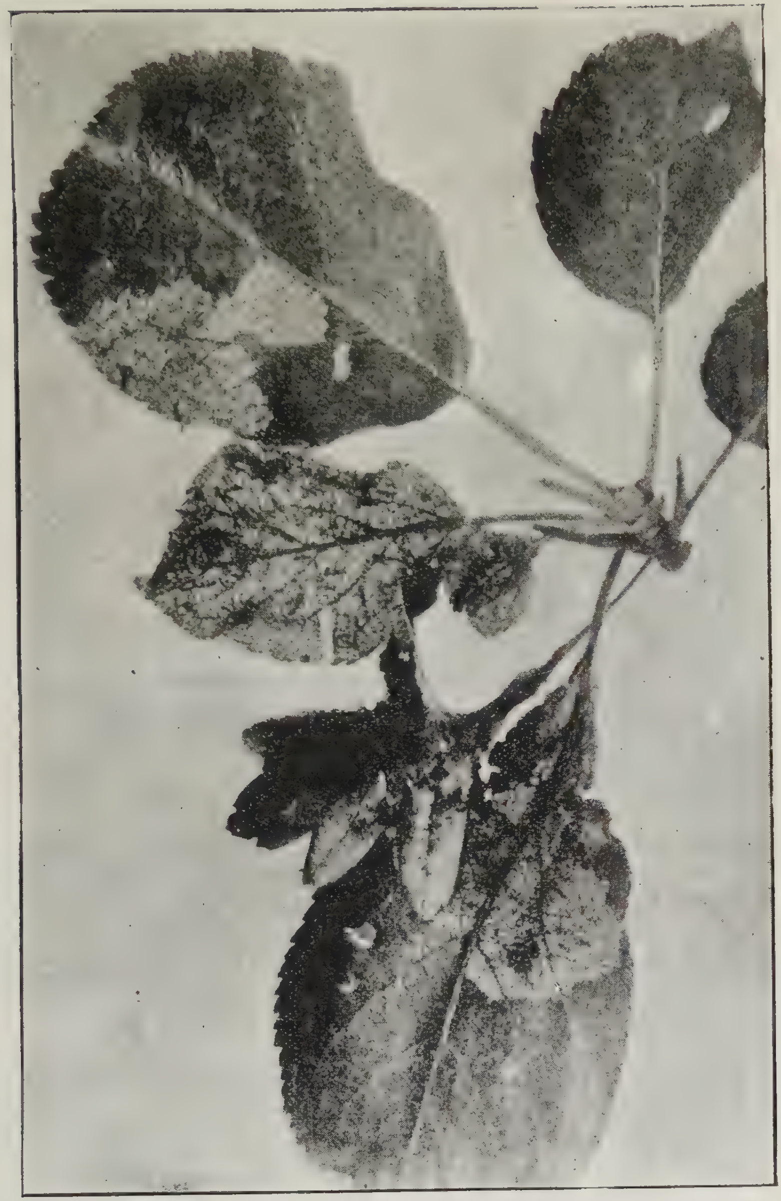


FIG. 26—Leaves eaten bp young caterpillars which have just emerged from egg mass at left, showing characteristic injury in fall.

nests as many as 300 caterpillars will live together until spring. These Brown-tail nests are 5 or 6 inches long, are conspicuous objects and are quite characteristic. Their removal and destruction are very essential in a campaign of extermination.

When spring comes the caterpillars begin feeding again on the new leaves, and become full grown about the middle of June. They then change to chrysalids within a silken cocoon, and a month later the adult white moths emerge and fly about. (Fig. 27).

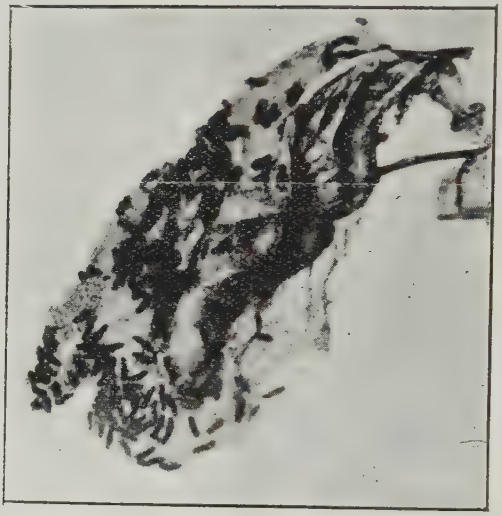


FIG. 27—Small Brown-Tail Moth caterpillars emerging from the winter web and feeding on the leaves of its surface.

A distressing feature of an invasion of caterpillars on shade and orchard trees is the great irritation to the human skin which is caused by their loose hairs floating everywhere in the air. The hairs are barbed, and when brought in contact with the skin they penetrate it, break off, and set up a painful irritation. This is know as the Brown-tail Rash, now a very common feature of districts infested by the Brown-tail moths.

While woodland trees, such as elm, oak, maple, are attacked by the Brown-tail caterpillars, other plants also suffer from their attacks, e.g., orchard trees, such as the apple and stone-fruits. In fact the caterpillars feed on most deciduous trees and shrubs and even upon herbage.

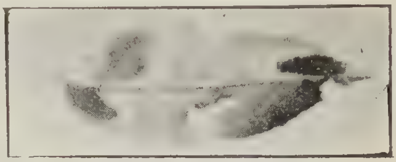
The best method of controlling this insect is, as already indicated, to cut and burn the winter nests. It is feared, however, that the pest, which has many means of spreading in these days of trolley lines and railways, may be present in a locality for some time before it is recognized by the general public.

SYNOPSIS OF LIFE HISTORY OF BROWN TAIL MOTH

(After SANDERSON)

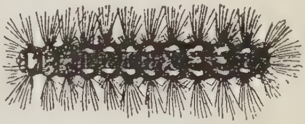
STAGES.

FIG. 21—EGG CLUSTER.



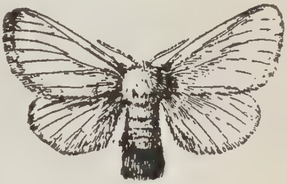
Always on under side of leaf Egg Cluster.
Smaller and more slender than gypsy moth eggs.
Dark or golden brown.
July

FIG. 22—CATERPILLAR.



Bright tawny or orange Caterpillar.
A conspicuous row of pure white spots or dashes along each side of body. Only two bright red spots on middle line at lower end of back.

FIG. 23—MOTH FEMALE.



Wings spread 1½ inches
Pure snow white.
A conspicuous, sharply contrasted, thick tuft or patch of golden and brownish hairs at tip of abdomen.
A swift, strong flyer by night, and attracted to lights.

FIG. 24—WINTER PASSED.

As small caterpillars in a silken web or nest on tips of twigs, from which they crawl out in spring.

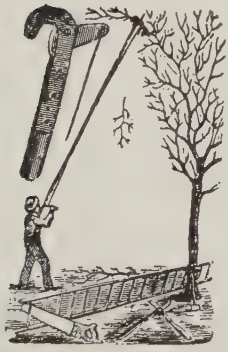


FIG. 25—IRRITATION.

Hairs from caterpillars, which are often transferred to cocoons and moths, cause an annoying and painful irritation of the skin.

MOST EFFECTIVE MEANS OF CONTROL.

Cut off and burn webs in winter.

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SECOND ANNUAL REPORT

OF THE

Quebec Society for the Protection of Plants from Insects and Fungous Diseases

1909-1910

PRINTED BY ORDER OF THE LEGISLATURE

QUEBEC:
LOUIS V. FILTEAU, KING'S PRINTER
1910

SECOND ANNUAL REPORT

of the

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

from

INSECTS AND FUNGOUS DISEASES.

1909-1910.

To the Honourable J. E. CARON, M.P.P.,
Minister of Agriculture,

Sir:—

I have the honour to present herewith the Second Annual Report of the Quebec Society for the Protection of Plants from Insects and Fungous Diseases, containing the proceedings of the Summer and Winter meetings of the Society, which were held at the Agricultural Institute at La Trappe, and Macdonald College, Ste. Anne de Bellevue, Que., on the 25th of August, 1909, and the 16th day of March, 1910, respectively.

Account is given of the papers that were read and the reports of the various officers of the Society.

I regret that owing to the disastrous destruction of the Montreal Herald Publishing Company's premises, the issue of this report has been seriously delayed. The fire completely destroyed both type and plates, necessitating new setting, the preparation of new plates, and much re-writing.

I have the honour to be, Sir,
Your obedient servant,
DOUGLAS WEIR,
Hon. Secretary-Treasurer.

Macdonald College, Que.
1910.

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS.

OFFICERS FOR 1910-1911.

President—William Lochhead, B.A., M.Sc., Professor of Biology, Macdonald College, Que.

Vice-President—Mr. Auguste Dupuis, Director of Experimental Fruit Stations, Village des Aulnaies, Que.

Hon. Secretary-Treasurer—Douglas Weir, B.S.A., M. Sc., Assistant in Biology, Macdonald College, Que.

Curator and Librarian—J. M. Swaine, M.Sc A., Lecturer in Zoology and Entomology, Macdonald College, Que.

Directors—Rev. Dr. Thos. Fyles, Hull, Que.; Rev. Brother Liguori, La Trappe, Que.; Rev. Geo. Ducharme, Rigaud, Que.; A. F. Winn, Esq., Montreal, Que.; Prof. G. Dimitriou, La Trappe, Que.

Auditors—J. M. Swaine, Macdonald College, Que.; Professor G. Dimitriou, Agricultural Institute, La Trappe.

MEMBERS OF THE QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS.

Arkell, H. S.	Dept. Agr., Ottawa.
Brittain, Dr. John	Macdonald College.
Blair, Prof. Saxby	" "
Bates, F. W.	" "
Barton, H.	" "
Brittain, Wm.	" "
Browne, F. S.	Bridgetown, N.S.
Buck, F. E	Macdonald College.
Campbell, Rev. Dr. Robt.	Montreal.
Chagnon, Geo.	"
Chapais, J. C.	St. Denis-en-bas, Que.
Cooley, R. B.	Macdonald College.
Cutler, G. H	" "
Davis, M. B.	Yarmouth, N.S.
Dimitriou, G.	La Trappe, Que.
Ducharme, Rev. Geo.	Rigaud, Que.
Dupuis, Auguste	Village des Aulnaies, Que.
Delaire, O. E.	St. Hyacinthe, Que.
Dasen, H.	Macdonald College.
Edouard, Rev. Brother	La Trappe.
Elford, Fred. C.	Macdonald College.
Fyles, Rev. Dr. Thos. W.	Hull, Que.
Grignon, Dr. W.	St. Adele, Que.
Grisdale, F.	Macdonald College.
Gardner, Prof. V. R.	University of Maine, U.S.A.
Hall, Lawdon	Cowansville, Que.
Hammond, H. S.	Macdonald College,
Harrison, Dr. F. C.	" "
Huard, Rev. Abbe	Laval University, Quebec City.
Jack, Norman, E.	Chateauguay Basin, Que.
Klinck, Prof. L. S.	Macdonald College.
Liguori, Rev. Brother	La Trappe, Que.
Lyman, Henry H.	Montreal.
Lochhead, Prof. Wm.	Macdonald College.
Logan, Wm.	" "
MacClement, Dr. W. T.	Queen's University, Kingston, Ont.
McClintock, L. D.	St. Andrews East, Que.
Moore, G. A.	Montreal.
Nantel, G. A.	Montreal.
Nagant, H.	Quebec City.
Newman, C. P.	Lachine Locks, Que.
Reid, Peter	Chateauguay Basin, Que.
Reid, T.	Macdonald College.
Savage, A.	Montreal.
Spencer, C. M.	Macdonald College
Swaine, J. M.	" "
Summerby, R.	Beech Ridge, Que.
Sweet, C.	North Sutton, Que.
Tourchot, A. L.	St. Hyacinthe, Que.
Vanderleck, J.	Macdonald College.
Victorin, Rev. Brother	Longueuil, Que.
Winn, A. F.	Montreal.
Williams, C.	Macdonald College.
Wood, G. W.	Genoa, Que.
Weir, Douglas	Macdonald College.

Honorary Member:

James W. Robertson, Esq., LL.D., C.M.G.

FINANCIAL STATEMENT

OF THE

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS FROM INSECTS AND FUNGOUS DISEASES,

1910.

RECEIPTS.

Brought forward	$ 189.14
Interest on deposit to June 30th, 1909	1.51
Provincial Government cheque for 1909	250.00
Interest on deposit to December 31st, 1909	4.73
	$ 445.38

DISBURSEMENTS.

Members Expenses to Winter Meeting	$ 13.65
Delegates to Legislature, *re* publishing of Annual Report	27.85
Investigation work on Weeds and Fungi	20.00
Printing of Report (English and French)	48.00
Stamps and Express	6.80
Stenographer	8.00
	$ 124.30
Balance, cash on hand, March 16th	321.08
	$ 445.38

DOUGLAS WEIR, *Hon. Sec.-Treas.*
WILLIAM LOCHHEAD, *President.*

Auditors :
J. M. SWAINE,
G. DIMITRIOU.

SECOND ANNUAL REPORT

# of the

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS.

Report of First Summer Outing.

Article 16 of the constitution and by-laws of the Quebec Society for the Protection of Plants provides that a summer excursion of the Society, for the purpose of studying any unusual outbreaks of disease or insect pests, and for collecting, shall be held during the month of August, the day and place of meeting to be decided upon by the Council.

The first summer outing of the kind was held on Wednesday, August 25th, 1909, at the Reverend Trappist Fathers' Agricultural Institute and Farm at La Trappe, Que. The following members of the Society were present:—

Messrs. G. Dimitriou, La Trappe.
O. E. Dallaire, St. Hyacinthe.
Rev. Father Edouard, La Trappe.
Peter Reid, Chateauguay Basin.
J. M. Swaine, Macdonald College.
Rev. Bro. Liguori, La Trappe.
Dr. W. Grignon, Ste. Adele.
J. C. Chapais, St. Denis de la Bouteillerie.
H. Nagant, Quebec City.
Douglas Weir, Macdonald College.

The forenoon was spent in searching the orchards, vineyards, vegetable gardens and adjacent woodlands for injurious insects and fungi, resulting in but few noxious forms being found, which speaks well for the excellent work being accomplished by the silent monks of Oka.

In the afternoon a very excellent meeting was held in the Institute Assembly Hall. In the absence of the President and Secretary, Rev. Brother Liguori, ex-Vice-President of the Society, was called to the chair and Mr. J. C. Chapais was asked to act as Secretary pro tem.

The Rev. Brother Liguori, in the course of a forcible address, appealed to all interested in Entomology and Mycology to become active members of the Society and aid in the fight against plant pests.

The speaker, in continuing, remarked that the Society depended largely upon the agricultural students and intelligent farmers of the province for the accomplishment of this work; that through their training along these lines they were able to recognize and understand the nature of these pests, and consequently to aid the Society in obtaining much needed data *re* the exact conditions throughout the province.

The Trappists are to be complimented upon the excellent condition of their several farm departments. Particular mention must be given the Ginseng Garden. which, after eight years of perseverance, is beginning to give very profitable returns.

Report of the Winter Meeting.

The Second Annual Winter Meeting of the Quebec Society for the Protection of Plants was held in the Biology Building of Macdonald College, Ste. Anne de Bellevue, Que., on Wednesday, March 16th, 1910.

The opening meeting was called to order at 2.00 p.m., the President, Prof. Lochhead, of Macdonald College occupying the chair. There were present:—

Mr. J. C. Chapais, St. Denis.
Rev. Brother Liguori, La Trappe.
Prof. Geo. Dimitriou, Agr. Ins., La Trappe.
Mr. F. Winn, Montreal.
Prof. L. S. Klinck, Macdonald College.
Prof. W. S. Blair, Macdonald College.
Rev. Dr. Campbell, Montreal.
Dr. F. C. Harrison, Macdonald College.
Prof. J. M. Swaine, Macdonald College.

Messrs. F. W. Bates, Macdonald College.
G. H. Cutler, " "
H. S. Hammond, " "
C. Williams, " "
Carl Sweet, " "
Wm. Logan, " "
Frank Grisdale, " "
F. E. Buck, " "
Robt. Summerby, " "
T. Reid " "
G. W. Wood, " "
C. M. Spencer, " "
Alf. Savage, " "
Douglas Weir, " "

The minutes of the last meeting were then read and approved. The Treasurer was then called upon for his report which, after being audited by Messrs. Swaine and Dimitriou, was found accurate and approved.

The question of the Society's voting a certain sum of money to assist members in the compilation of a check list of injurious insects of the Province of Quebec then came up for discussion, and after careful consideration, it was proposed by Mr. Chapais, and seconded by Rev. Dr. Campbell, "that the sum of fifty dollars be at the disposal of those members of the Society who are willing to undertake the examination of collections and the preparation of a catalogue of the noxious insects of Quebec. The allotment of money to be made by a Committee composed of the President and the Secretary-Treasurer." Carried.

The election of officers for the ensuing year resulted as follows:—

President—Prof. W. Lochhead, Macdonald College.
Vice-President—Auguste Dupuis, Village des Aulnaies.
Secretary-Treasurer—Douglas Weir, Macdonald College.
Curator of Museum—J. M. Swaine, Macdonald College.

Board of Directors:—

Rev. Brother Liguori, La Trappe.
Dr. Thos. Fyles, Hull, Que.
G. Ducharme, Rigaud.
A. F. Winn, Montreal.
G. Dimitriou, La Trappe.

The business of the meeting being disposed of, the President, Prof Lochhead, delivered his annual address.

THE PRESIDENT'S ADDRESS.

Gentlemen:—

" It is again my pleasant duty to welcome you to this the second winter meeting of the Quebec Society for the Protection of Plants. It is exceedingly gratifying to note the increasing interest in the work of this Society, not only by our own members but also by the public. Several new members have been added to our list during the year, and these no doubt will contribute materially to the valuable work that is being done.

" I stated in my address last year that a Society such as ours cannot hope to bring about in a year or two any marked change in the mode of treatment of plants whereby they will be better protected against fungous diseases and insect pests, for the education of the general public is at best a slow process. Many years of constant work, repeated over and over again, will be required before the results of our labours can be readily seen. We may not live to see the time when the best methods will be generally practised throughout this province, but if we do our duty faithfully and well we may leave the world with the happy assurance that our successors will see the fruits of our labours as well as theirs.

"Since our last winter meeting, a summer meeting was held at La Trappe in August. Unfortunately, I was unable to be present owing to pressing duties that prevented me from leaving Ste. Anne's. I was informed, however, that those of our members present on that occasion had a pleasant and profitable meeting.

" It is with pleasure that I refer to the warm tokens of appreciation with which our First Annual Report was received. The members of the Pomological Society look upon it as satisfying a long-felt want, and they were very pleased to have it bound along with their own report. As you are aware, considerable attention was given to the chief fungous diseases and insect pests of the orchard, concerning which many of our orchardists were desirous of the latest information. I am sure it is the wish of the members of this Society that the fruit-growers will find in our future reports that sort of information that will enable them to cope with the enemies that work so much destruction and loss.

"The vegetable growers and the florists have also heard of our Society, and they, too, are asking for help along similar lines. Accordingly, some of the articles in the forthcoming report will deal with the pests of the garden and the greenhouse.

" Moreover, the farmers have been asking help from us with reference to two or three insect pests that appeared in larger numbers than usual the past season; I refer to the grasshoppers and blister beetles.

" That our Society is winning its way into favour is shown by the fact that the Chairman of the section on agricultural resources of the National Commission on Conservation of Natural Resources has invited this Society to co-operate with him in the investigation of the insect, fungus, and weed pests of one or two areas in this province. By a thorough study of these pests of a district it is believed that practical methods can be devised whereby much loss may be averted, not only in the particular district studied but also over the entire country when aided by grants from the Commission. I believe the Premier, Sir Lomer Gouin, expressed his entire willingness to have our Society co-operate with the Commission in any earnest effort to get control over the pests which are inflicting millions of dollars of loss annually.

" Here is an excellent opportunity to show the value of a Society such as ours. If we can make an investigation of such a careful nature in a township that we can show approximately the loss every year from weeds, insects and fungi; how these are spread and how they may be prevented from spreading; the effect of different systems of farming on their control; the influence of drainage and rotation of crops on the development of the pests, etc., the commission will have a good basis for extended action in other parts of the country, and will be in a position to ask the Parliament of Canada for funds to carry on the work.

" Several of our members have been doing good work during the past year. Mr. Swaine has been investigating the bark beetles that work so much damage to forest trees, and gave addresses before the Montreal Florists' Club and the Pomological Society on injurious insects. I, myself, spent four or five days studying the weeds of the Eastern Townships; I gave two addresses before the Montreal Florists' Club on the Fungous Diseases Affecting Greenhouse Plants, an address before the vegetable growers of Cote des Neiges, and an address before the Montreal Women's Club on the Care of Shade Trees. Others, doubtless, have helped along the movement for which our Society stands by giving addresses and talks on the more injurious pests before gatherings of various sorts.

" It is the privilege of the President to roam at will in his address. I have used my privilege and have touched upon many things that ought to interest you. In conclusion, I shall refer briefly to the present tendencies in the study and investigation of plant diseases and insect pests.

"A careful examination of the publications of the last few years reveals a great amount of work done on old problems. The old problems have been attacked anew with new weapons, with more experience, and with a better knowledge of related problems. Investigations relating to the Codling Moth, the Curculio and Apple Scab have yielded a large amount of new and valuable information. The study of the biological relations of organisms, that is, the relation of one organism to another, and of the organism to its environment, is receiving much attention at the present time, and much fresh light has been thrown upon the life-histories of many of our economic plants and animals.

"As workers in economic biology, we are indeed fortunate in having so many valuable books of reference to aid us. Not many years ago the study of insects and plant diseases was slow and unsatisfactory on account of the scarcity of available reference and text-books, and beginners were often discouraged at the outset. I beg to call your attention to a recent work by Prof. B. M. Duggar, of Cornell University, entitled, "Fungous Diseases of Plants," published by Ginn & Company, of Boston. In my judgment it is the best work on the subject that we have in America, and every student of plant diseases should possess a copy for ready reference.

"In conclusion, gentlemen, may I again remind you of the importance of our work as a Society to the province. Millions of dollars of valuable plants are destroyed every year by insects and fungous diseases, and it is our privilege and duty to take the lead in devising ways and means of preventing such losses.

"The Government of the province continues to show its interest in us by giving us a grant to hold our meetings and by printing our report."

A number of very excellent papers were read during the afternoon, which called forth a great deal of discussion. Prof. Klinck spoke on the "Susceptibility of Certain Crops to Smut." Mr. Hammond's paper dealt with the "Influence of Fertilizers on Disease in Plants." He was followed by Prof. Dimitriou on "The Control of a Noxious Mildew of Cereals." Mr. Chapais dealt with the "Carrot Fly." District reports on insects and fungi were then presented, Mr. Dupuis reporting for the Quebec district and Mr. Winn for Montreal.

NOTE.—Since the above was written three excellent books on economic fungi have appeared: Selby's *Handbook of the Diseases of Cultivated Plants*, Bulletin 214, Ohio Agric. Exp. Station.; Stevens & Hall's *Diseases of Economic Plants*, Macmillan Co., New York; and Massee's *Diseases of Cultivated Plants and Trees*. Duckworth & Co., London.

Mr. Vanderleck spoke on "The Causes of Gum Excrescence in Fruit Trees," and Prof. Blair on "The Capacity of Certain Varieties of Potatoes to Resist Blight."

The afternoon meeting adjourned at 5.45, to meet again at 7.30, when illustrated lectures were given.

Prof. Lochhead presided at the evening meeting, at which a paper on the "Fleshy Fungi of 1909" was given by the Rev. Dr. Robert Campbell, of Montreal, who presented some fine specimens to the College Museum.

Dr. Harrison gave an illustrated address on "Bacteria and Their Relation to Plant Diseases." It is unfortunate that Dr. Harrison was unable to prepare a written account of his lecture, and owing to the lecture being illustrated with lantern slides it was impossible to take anything like copious notes. However, mention must be made of a bacterial disease of beans, or "'Bacteriosis of Beans," which the speaker proved to be causing loss and injury in the bean-growing sections of the province.

The disease usually begins at the margin of the leaf, or where the leaf has been injured or torn by insects, wind or hail. Here a yellow spot appears, and the green of the leaf is destroyed. The spot increases rather slowly and the diseased tissues become brown, eventually breaking away or remaining withered on the stem. The disease enters the stem by the leaf stalk and advances in the stem to other leaves and to the young pods. In some cases the pod may wilt and die and on opening it the half grown seeds are found shrivelled and discoloured. The disease is caused by Pseudomonas phaseoli, (Erwin & Smith).

The methods of eradication suggested were:—

1. Infested seed should not be planted.

2. Fields where the disease has occurred are unfit for profitable bean growing for at least one season, the germ living over in stems and leaves left on the ground.

3. Infested bean straw should be burned. If fed to animals or used for bedding the germs are apt to be spread to uninfested parts.

In addition to the Bean Bacteriosis, mention was made of the "Soft Rot of White Turnips, Cauliflowers and Cabbages," and the "Bacterial Rot of Celery."

Before the meeting concluded Prof. Lochhead gave a paper on the "Crown Gall of the Apple and Peach," which is given verbatim in this report.

After a hearty vote of thanks had been given to the speakers for their interesting and valuable addresses the meeting adjourned.

THE SUSCEPTIBILILTY OF CERTAIN CEREALS TO SMUT.

Leonard S. Klinck, Macdonald College.

That certain varieties of cereals are more susceptible to the attacks of smut than others is a matter of common knowledge. This fact should be borne in mind by every breeder of small grains when making his selections for foundation stocks. Much valuable time has been lost and much money needlessly spent in attempting to breed strains resistent to certain diseases when varieties, nearly immune naturally, already existed.

In order, therefore, to secure information as to the degree of smut resistance naturally possessed by the different varieties of cereals under test at the College, no grain sown on the plots has been treated for smut for the past four years. After a lapse of two years, in order to allow the influence of former treatments to be largely overcome, we began making a count of the actual number of heads smutted appearing in each variety. The heads were gathered three times a week during the period when the smut was in evidence and a record made of the number found on each plot. Since the results obtained cover a period of but one year in some cases, and but two years in other cases, the conclusions drawn should be regarded as tentative and suggestive rather than conclusive.

A study of results obtained would indicate that the following factors play an important part in determining the amount of smut:—

First—Season.

Second—Class of Grain. Milling spring wheats are more susceptible than durum wheats. Two-rowed Duckbill barleys are less resistant than two-rowed Chevalier barleys. The Chevalier, in turn, is much more susceptible than the average six-rowed class while the hulless varieties appear practically immune.

Third—Variety. In the milling spring wheats, Pringle's Champion gave 1 smutted head; Huron, 293. In the durum wheats, Medeah gave 1 smutted head; Roumanian, 147. In the six-rowed barleys, Oderbrucker gave 1 smutted head; California Brewing, 341. Two-rowed Duckbill gave as high as 364 smutted heads; two-rowed Chevalier as high as 50. Of four varieties of hulless barleys tested three did not produce a smutted head while the fourth produced but one.

Fourth—Strain. Of three strains of Red Fife wheat, obtained from widely-removed sources, the most resistent produced 24, the second 108 and the third 278 smutted heads respectively.

Fifth—Date of Seeding. This does not appear, from two years' results, to be an important factor. Deferred seedings gave the fewest smutted heads but the yield of grain was low and the quality poor.

Sixth—Size of Seed. When equal weights of large, medium and small seeds respectively were sown, the plots sown with small seeds, in the case of wheat and barley, gave by far the greatest number of affected heads. No difference, however, was shown in oats. When the same grades of grains were sown by number the same results were obtained with the exception that the number of smutted heads, in the case of barley, was more nearly uniform.

Seventh—Rate of Seeding. Contrary to what might have been expected, the number of smutted heads in wheat, barley and oats, sown on land in good heart, bore almost no relation to the amount of seed sown. This also held true with barley on very poor land, but in the case of oats there was a marked diminution in the number of diseased plants on the thinly-seeded plots.

Eighth—Date of Cutting Oats. The later the cutting the higher was the per cent. of smut. Seed taken from the early-cut plots produced much more smut the following year than seed allowed to mature thoroughly on the standing straw.

Ninth—Drilling vs. Broadcasting. Results would strongly indicate that barley and oats, drilled, are much more liable to injury from smut than when broadcasted. This conclusion is in accordance with the generally-accepted belief of growers.

These experiments are being continued and it is hoped that at the end of a five years' test results of much greater value will be available.

THE MILDEW OF CEREALS.

G. Dimitriou, I.A.O., La Trappe.

Introduction.

Research such as the application of the most effective means of combatting the fungous diseases of our cultivated plants, demands a thorough knowledge of these fungi. Indeed, if one may judge by what is actually known regarding the phases of development of plant fungi, of their multiplication, of their mode of attack and of their resistance to all the destructive agents, these circumstances vary so that general rules for their destruction can be absolutely established only after a special study of the life of each of these fungi. It is an indispensable condition for their successful control.

The united movement for the protection of plants against their natural enemies, vegetable or animal, is of recent date in the Province of Quebec. It can be largely attributed to the organization of the "Society for the Protection of Plants," and to the continuous efforts of its President and of his colleagues.

Historical.

In the experimental plots of the Agricultural Institute of Oka, set apart for the acclimatization of certain varieties of wheat, a somewhat sudden change became manifest at flowering time in the uniformity of the green color of the lower leaves of the stems of this cereal. Soon this change of color spread in all directions.

Other varieties of wheat and rye growing alongside had a dusty appearance. The change appeared to have reached its maximum intensity after the rain on the 5th and 6th July. It showed itself principally by secondary bushy tufts on the leaves, while the stems had not yet appeared. A little later the disease invaded another part of the garden containing selection plots of the two varieties, viz., rye—"Common," "Ottawa select" and wheat—"Red Fife" and "Preston." The leaves withered at a time when the plant had the greatest need for the elaboration of food materials of the seed. The fungus appeared most vigorous on the borders of the selection plots where the lower leaves presented the worst appearance. It is to this white-ashy color of the leaf affected by the fungus that it owes the name **blanc des cereales** (mildew of cereals)—(Alphitomorpha communis—oidium monilioides—Erysiphe graminis).

Morphological Development of Erysiphe.

A cereal leaf affected by the mildew shows velvety spots of an ashy color at first and brown later; elliptical in outline; irregular; from two to three lines long and one to one and a half wide; more common but smaller on the upper surface, and occupying without preference any place on the entire surface of the leaf. These spots are quite insignificant on the leaf sheath (Fig. 1).

Under the objective of the microscope these velvety spots take on the appearance of a colourless mass of tangled threads, the whole forming a downy cushion, becoming brown later. Under a stronger magnification

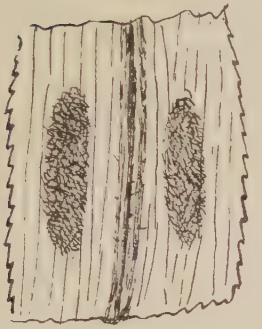


Fig. 1—Erysiphe graminis.
Appearance of Summer Mycelium tufts on a leaf.

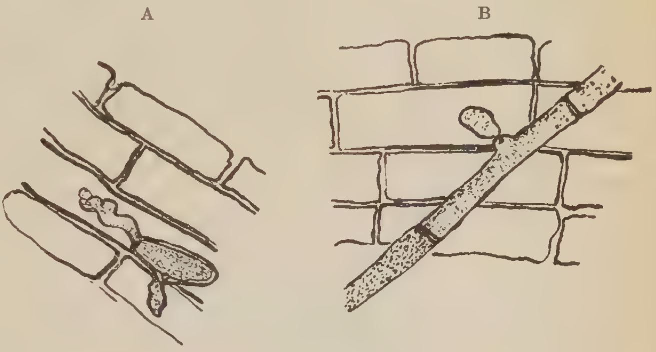


Fig. 2—Erysiphe graminis.
Figure A shows a thread of the Mycelium with a sucker or haustorium;
Figure B show the germination of a summer spore on a leaf.

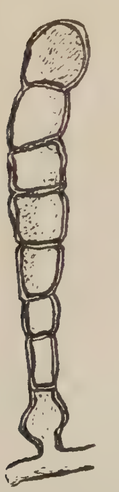


Fig. 3—Conidium form of Erysiphe graminis.

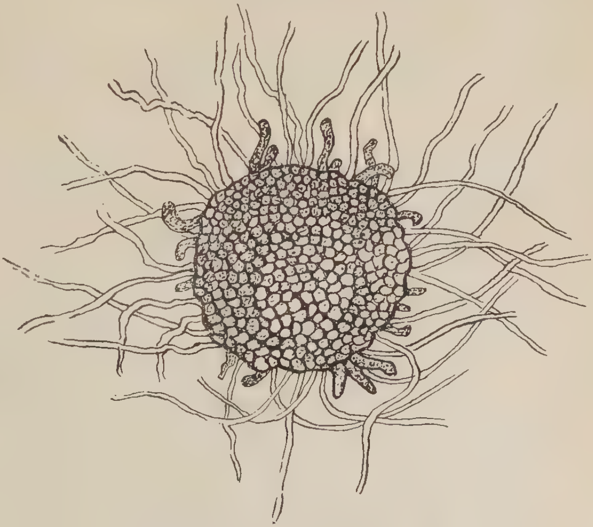


Fig. 4—Perithecium of Erysiphe graminis.

two stages of the fungus can be observed, viz., the **vegetative** or the **mycelial** stage (Fig. 2) and the **reproductive** or the Conidal stage (Fig. 3). The first is represented by the mycelium which creeps on the epidermis and sends down here and there slender cellular prolongations which penetrate the cell wall and swell up within the cell, forming clasping, sucker-like organs called haustoria. These permit it to live at the expense of the host plant. On the mycelial threads throughout their entire length arise other threads composed of egg-shaped spores arranged in the form of beads. Such spores, 6 to 8 in number, are called **conidia** and form the conidal stage of the fungus (Fig. 3). As soon as the fungus matures the conidia are detached and are carried by the wind to favorable plots that the plant itself, or other neighboring plants, procures for them. If the spore finds there conditions of humidity slightly favorable it takes longer to develop. On the contrary, if the humidity be favorable the condidium germinates by sending out two short germ tubes into which passes the contents of the spore (Fig. 2). The first duty of the spore is to fix itself to the epidermis. After Wolf, the end of one of the tubes sends out a prolongation which pierces the cell wall to form an attachment, while the other germ tube develops mycelial threads like those described above. Towards the end of the vegetative period of the host plant, which is hastened by the development of the disease, the production of condidia becomes more rare; while on the contrary, the contiguous threads of the mycelium in those parts where they are best fixed by haustoria, fuse and form branches. These send out other branches which in their turn come together and fuse. From this confused mass of threads are formed rounded, brownish bodies, immersed in a mass of mycelial threads and presenting a characteristic roughness. These are the **perithecia** which can be likened to fruits containing seeds (Fig. 4). In this state this "fruit" serves to preserve the species against the severe conditions of winter. It detaches itself from the leaf, falls on the ground whence it is carried by the wind. A transverse section of the **perithecium** shows 8 to 15 asci which are

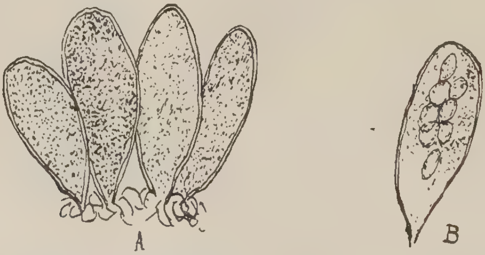


Fig. 5—Erysiphe graminis.—(A) a bundle of spore sacs or asci; (B) an ascus with its contained spores.

formed in the autumn from a homogeneous mass (Fig. 5A). In spring this mass differentiates and produces in its interior 6 to 8 elliptical ascospores which under favorable conditions germinate like condidia and begin again the cycle of vegetation of the Erysiphe (Fig. 5B). A good section of a perithecium in our laboratory showed three asci, only, the others being concealed in the cavity of the perithecium left intact by the razor.

Injuries caused by Erysiphe graminis.

In our selection plots wheat, rye and barley have suffered the greatest injury by this disease. Alone or sometimes with other fungi, such as Helminthosporium, Puccinia, etc., it takes possession of a part of the surface of the epidermis, and thrives at the expense of the food materials of the host plant, besides probably preventing the proper functioning of chlorophyll in the parts of the leaf occupied by the spots.

Curative and Preventive Remedies.

From 1885 to 1889 the disease appeared in the neighbourhood of Stockholm with such intensity that the cultivation of cereals was seriously threatened. Prillieux cities the applications of flowers of sulphur as a curative remedy that the farmers of Stockholm employed to save their crops. In France the application of flowers of sulphur against the grape disease (Uncinula spiralis or Oidium Tuckeri), caused by a fungus analogous to the Erysiphe, has given very good results.

In particular instances like that of our selection plots it is possible to scatter flowers of sulphur on the leaves of affected plants, nevertheless. sulphur application to a large crop, although possible, meets with practical difficulties. For this reason it is scarcely recommended.

The most effective means of controlling the disease seems to be rather one of prevention. It consists in the creation of resistant varieties. This can be attained by the choice of stalks that have not been attacked by the fungus. In making the selection it is therefore of importance to avoid selecting the heads borne by plants occupying the borders of the plots, inasmuch as they are more exposed to the disease.

In late summer or at the beginning of autumn the spontaneous vegetation of weeds and of seed shelled from the cereal occupying the ground is covered by a white down which appears like a coating of milk of lime sprinkled on the leaves. The humidity produced by dew of the cool nights favors the development of Erysyphe.

Moreover, the destruction of these weeds makes necessary the tillage of the land before the work of autumn. It may be well to add that the growing of the same cereal on the same land for two or more consecutive years tends to increase the grievous consequences of this disease.

FOUR COMMON FUNGOUS DISEASES OF THE GARDEN.

W. Lochhead, Macdonald College.

1. Gooseberry Mildew.

(Sphaerotheca mors-uvae, B. & C.)

This disease is so destructive to English varieties of gooseberries in some localities that it is difficult to harvest a crop. The leaves and shoots as well as the fruit are attacked and become covered with a fine whitish cobweb-like growth of mycelium and a delicate white powder. This powder is composed of myriads of summer spores called conidia, which are produced in chains on erect threads of the mycelium. These conidia are readily carried from one bush to another, so the disease spreads rapidly. Later in the season minute roundish brownish black bodies, the perithecia, are formed on the mycelium, each with a roundish sac within containing eight colourless spores. These ascospores, or winter spores, remain within the perithecia all winter, and are liberated in the spring. When they are blown by the wind to the new leaves of the gooseberry, under favorable conditions they will germinate and infect the plant. The disease is in this way enabled to develop from one season to the next.

At first the mycelium covering the affected parts is very dense and white, but the threads soon become brown and thick-walled.

The fungus derives its nourishment from its host by means of minute sucker-like branches, **haustoria**, of the mycelium, which penetrate the skin or epidermis and feed upon the contents of the cells. The disease attacks the gooseberry early in the season, and is usually observed first in the shaded parts of the plant. Young shoots are often so sapped of their vitality that growth is prevented and fruit buds do not develop.

Treatment.—As a rule the powdery mildews, to which the Gooseberry Mildew belongs, are readily controlled by Bordeaux and other fungicides, since they live on the surface of their hosts, but this disease is an exception. Much difficulty has been found in controlling the spread in spite of repeated applications. Experiments conducted by many growers show that good results are secured by the repeated application of potassium sulphide at the rate of 1 ounce to 2 gallons of water. The first spraying should be made when the buds open and subsequent applications every ten or twelve days. In some cases the leaves are destroyed by this treatment. Lime-sulphur wash applied in fall and spring while the plants are dormant has also given good results and will probably become the standard remedy. It is advisable also to give a thorough application after the fruit is gathered.

2. Currant Anthracnose.

(Gloeosporium ribis, M. & D. Pseudopeziza ribis, Kleb.)

This disease is a common one on both red and white currants, and is sometimes found on the black currant and the gooseberry. It attacks the leaves, petioles, canes, fruit and fruit-stalks. The most serious injury is done by the premature falling of the affected leaves in July or August. The disease causes a spotting of the leaves and slightly sunken light-colored areas on the petioles and canes. The spores are one-celled and curved in form. They are borne on short stalks which arise from a denser portion of mycelium embedded in the tissue, the whole forming a pustule. These pustules are abundant on both sides of the leaf, being more numerous, however, on the upper surface.

There has lately been discovered (1906) a winter-form of this fungus in fallen leaves that have wintered over under suitable conditions. The spores are borne in club-shaped sacs situated in a fleshy disc-shaped structure. Each sac or acus has eight oval spores. On account of the discovery the name of the fungus is now known as **Pseudopeziza ribis.** The winter, or ascospores, upon inoculation of growing leaves develop in time the Gloeosporium or summer stage, as it is commonly recognized.

Treatment—The dead leaves and rubbish should be raked and burned, and two or three applications of Bordeaux—the first in June—will keep the disease under control.

3. Raspberry Anthracnose.

(Gloeosporium venetum, Speg.)

This is usually a more serious disease than the preceding one. It attacks the canes and sometimes appears on the leaves and young shoots. The presence of the fungus is readily recognized by the purplish spots, which later become grayish in the centre, presenting a bird's eye effect. These spots in severe cases become confluent, and girdle the stem, when the fruit and leaves dry up and die for lack of moisture and plant food. Macoun says that affected plants suffer most during the second season when the disease has usually spread so much that a large proportion of the canes and smaller stems are affected.

The fruiting spots of the fungus may be observed in the gray central portion of the spotted areas on the canes (Fig. 1). The spores are minute and curved; at maturity they escape from beneath the cuticle in a gummy substance which dries on exposure to the air and sets the spores free. They are readily blown by the wind, and may germinate at once and infect new canes.

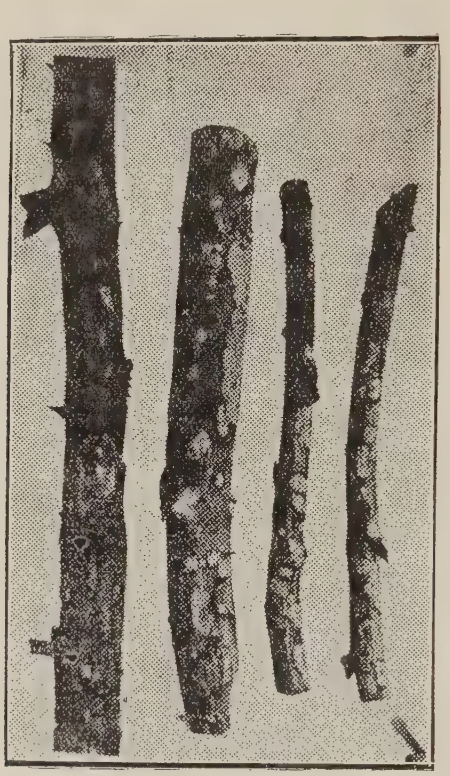


Fig: 1—Canes of Raspberry showing spots produced by anthracnose,

From the fact that no winter form of spore has yet been found it is believed that the mycelium winters over within the tissues of affected plants.

Treatment—This is a difficult disease to control, and fungicides alone are not sufficient to keep it in check. Diseased canes as well as the diseased leaves should be removed and burned; care should be taken to set out none but healthy plants. and three or four applications of Bordeaux should be given early in the season. The first spraying should be applied before the leaf buds open; the second just after the young canes appear above ground; the third two weeks later; and the fourth just before the flowers open.

4. Strawberry Leaf Spot.

(Mycosphaerella fragariae, Lindau.)

The Strawberry Leaf Spot is present more or less in every plot of strawberries, but only occasionally does it injure the crop to any extent. Affected leaves show at first about blossoming time small purplish spots, which soon enlarge and run together forming somewhat irregular areas.

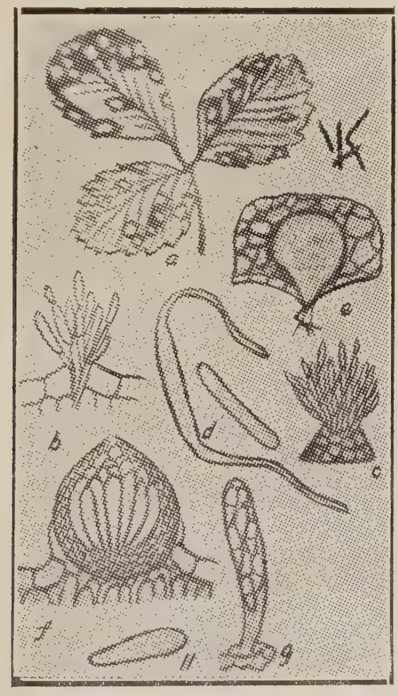


Fig. 2—(a) A leaf of strawberry affected with leaf blight; (b) spore-bearing tuft of mycelium bursting through the epidermis of the leaf; (c) summer spores arising from apex of a resting spore case; (d) summer spores (conidia), one germinating; (e) section of a spore pustule (spermogonium) produced in summer; (f) section of resting or winter spore case (perithecium), found in tissues of old diseased leaves which have lain on the ground over winter; (g) a spore sac (ascus) containing eight two-celled winter spores; (h) winter spore (ascospore) very highly magnified. (Longyear.)

These diseased spots become white and are surrounded with a purplish border. On these dead, white areas may be found in early summer blackish specks which are the fruit-spots of the fungus. When examined carefully each speck is seen to be composed of minute tufts of spore-bearing stalks which arise from a mass of mycelium lying beneath the epidermis. On the rupture of the epidermis the spores are set free and are capable of spreading the disease during the summer. A winter form of spore is also produced in autumn on leaves that have been killed by the fungus. Such spores (ascospores) are borne in sacs enclosed in black perithecia which in turn are embedded within the tissues of the leaf. Each perithecium has a projecting mouth or opening through which the spores at maturity escape in the spring. There are several sacs (asci) in each perithecium, and eight two-celled spores in each sac. These winter spores are capable of starting the disease afresh on the new leaves (Fig. 2).

Treatment—The leaves should be removed and burned after the fruit is picked so as to destroy the winter form of the fungus. The plants should be sprayed twice with Bordeaux, once when the new leaves are appearing and again before the flowers open. Only healthy unspotted plants should be set out. The practice of setting out a new plantation every year prevents the development of the disease.

THE CAUSES OF GUM EXCRESCENCE IN FRUIT TREES.

J. Vanderleck, Macdonald College.

In accordance with the programme I am here to-night to give you a short address on the causes of gum excrescence in fruit trees. You must not expect, however, to hear from me a detailed description of the way in which the ill-fated plant cells are changed into gum, for I do not think that such knowledge would be of much use to the practical fruit grower. Not that the gum production is not of the greatest importance to the tree itself; for gum is produced out of the best food products available, such as starch, sugar, etc., and so we see valuable food material changed into valueless gum. It was an investigation of the causes of the gum production in fruit trees which made me acquainted with that vast world in which plants and bacteria fight out their great battles, and I hope to-night to communicate to you some of the astonishing facts which came to my knowledge during that research.

One day six years ago I was working in my laboratory when I was visited by a Doctor of Botany who was investigating the causes of the gum production in certain trees. After numerous elaborate experiments he had come to the conclusion that bacteria played an important part in these changes and as our learned friend knew as much about bacteriology as I knew about botany, he came to me and suggested that we should undertake these investigations together.

It may seem strange to you that he came to me but the very fact that I did not know much about botany made co-operation easier than if he had consulted a man with fixed ideas upon the subject of botany, who would not have seen things in the same light. It was this that led me so unexpectedly into this new field of science, and it did not take us long to isolate several organisms which caused gum production or gummosis, as it is called, in fruit trees inoculated with them. Our results, combined with the facts of other investigators, showed us that gummosis could be caused in four different ways. In the first place by bacteria, second by fungi, third by animals, and fourth by other causes.

1. Bacteria—The diseases of grapes, peaches, prunes, olives, which are characterized by gummosis, are all caused by one special bacterial organism called Bacterium gummosis. Cherry trees suffer also from a similar disease, but this disease is caused by another bacterial species. The gum production is characteristic of these bacteria, and it is not at all necessary that they live on the plants to produce the gum, but they can also make gum on other suitable substances.

2. Fungi—The second group which contains the gummosis causing fungi is much better studied, and numerous varieties are known, especially (1) the **Clasterosporium carpophilum** is found on numerous stone fruits. Its presence may be determined in the following manner:

(a) On the leaves—dead brown spots 1-5 of an inch in diameter. They are distinguished with difficulty from other spots on the leaves, but have a clear centre and a red outline. The spots often fall out of the leaves.

(b) On the petioles—no characteristic changes can be seen on the petioles, although sometimes small drops of gum may be present. Leaves of which the petioles are badly diseased fall off; the cherry especially is attacked in this way, and the fungus is seldom found on other parts.

(c) On the branches—especially branches of peach trees one to two years old are attacked. On young wood the spots are round, sunken, brown or blackish-brown, often with a red outline.

(d) On the fruit—on fruit the disease may appear at any time, and the spots have a red outline.

This fungus is often mentioned in literature as the cause of holes in leaves of trees in general.

Another fungus was found in 1903 during an epidemic among the cherry trees along the Rhine. All the infected trees showed much gummosis; it was discovered on that occasion that the fungus was unable to attack healthy trees, but penetrated into injuries or wounds and caused the death of a few cells; once established on these dead parts it penetrated the healthy bark and wood and often caused the death of the tree. At all seasons of the year large branch systems and heavy trees died suddenly once the fungus had taken possession of them. The dividing line between the living and dead part is very clear and large quantities of gum appear. The growth of the fungus is favored by dry weather. Many other instances are mentioned in which damaged trees are attacked by organisms. For example, the prunus Japonica is often killed by a fungus which enters through small wounds in the bark, broken branches or places where buds of leaves or flowers are broken off.

Further, I remember an epidemic at an Experimental Station among the two-year old wild cherry trees and the improved cherry trees which were grafted in the crown.

The bark was dead in several places and large quantities of gum had collected on these spots, where such a ring of gum went all round the trunk the tree died. An investigation showed that the gum was full of bacteria and that the trouble had started at the incision in some dead cell tissue.

Monilia disease of cherry trees is an exception, for the fungus can affect the plant without the latter being injured. Spores of the fungus are blown by the wind or brought by insects on the pestles of the flowers and there germinate. From the first flower the whole branch is attacked and dies. The same fungus forms a rot on peaches and a blight on the branches of the peach tree. It is not necessary that the skin be injured beforehand. I could mention several other instances of fungi which attack especially fruit trees, but the ones mentioned are more generally known.

In nearly every case the fruit must be injured before the fungi can establish themselves.

(3) **Animals**—In the third place I have mentioned animals, but speaking of animals I do not mean rabbits or dogs, but more especially insects. This is, however, so far away from my own line of study that I will only mention a few names, names which I am sure are quite familiar to you, such as Grapholitha woeberiania, Schiff; Eccoptogaster Pruni, Ratz.

(4) **Other causes**—Under the fourth heading we can bring all cases not yet mentioned before. So gummosis is caused by the presence of too much food in one spot, which causes the death of a number of cells. Many other cases are on record in which gummosis produced through pressing, cutting, supplanting or frost, but all can be brought back to the presence of wounds, as in the case of graft, where the dying cells cause gummosis. Cherry flowers strongly damaged by frost show gummosis on the line between the dead and living part of the petioles.

At the time when I conducted these investigations I was very much impressed by the fact that fruit trees were so easily killed by bacteria and similar organisms. To my mind a tree had been something lasting, a thing so substantial that it did not follow the rules of nature to which we human beings are subject. It did not make any difference to a tree whether a name was cut in it, a piece of the bark taken away or leaves torn off, the tree continued to grow as if nothing had happened. How different such a tree was in comparison with us, with our weak constitutions and our continual dread of bacteria. When we cut ourselves or sustain some other slight injury, blood poisoning is smiling in our faces, and we have to apply numerous disinfectants to keep the crowds of bacteria outside the porch. And, now, it appeared that a tree was in the same poor condition as we are, that a tree is also besieged by untold bacteria which just wait for an opportunity to take the very life out of it. In the cases of fruit tree diseases already stated we find generally mentioned that organisms got in through small wounds, established themselves on some dead material and from there attacked and brought down that tree and sometimes the whole orchard.

It is not a very cheerful idea to think that a small street urchin throwing a stone at one of your cherry trees may cause the loss of the whole orchard, if only the special organisms are present to establish themselves in the injured spot. This is no exaggeration, several similar cases are on record, and the only way to protect our orchards is to remove all causes of infection and to keep all trees as healthy as possible. In 1904 an epidemic was raging in the cherry orchards in Germany, and the trouble was traced back to one orchard where a large tree had been struck by lightning during a severe thunderstorm. The owner of that orchard left that tree as it was and one of these dangerous ascomycetes took possession of that severely wounded tree and spread from there over a large area. The loss involved in this epidemic was considerable, all caused by the ignorance of one man. It was here a case of ignorance, for the owner of the orchard did not know that this damaged tree was dangerous to the other trees in the neighbourhood, and at present very few people would view the matter from such a standpoint. In this respect we have to struggle through the same difficulties as in the time that people did not see the necessity of sanitary and hygienic conditions for themselves. This problem is solved; everybody knows the danger of the surrounding bacteria and the necessity of taking measures. The time will come when we will do the same for our orchards.

To finish this address I will give the results of our personal investigations of several cases in which cherry trees suddenly died under appearance of gummosis. We have always been able to isolate an organism and to locate the spot from which the infection started, and we were always particularly anxious to find out in what way such a tree had become injured, and the results of some of our findings were most surprising. In five cases blackbirds had been picking unripe cherries; in two instances leaves had been torn off by visitors, in five cases there had been frost when the trees were in bloom, and last, but not least, two cats had been fighting in a cherry tree.

These were only a few instances in which we could detect the cause with certainty.

Add to this the injuries caused by insects and you will come to the conclusion that at present there should not be one cherry tree on this earth. It is with this as with our human troubles, theoretically, we should all be destroyed by bacteria before we have seen daylight, but there are such things as luck and chance in this world and we must thank them for the fact that our orchards are in such good condition in spite of the fact that we do nothing to save them.

CLIMATE AND INSECTS.

T. C. Chapais, St. Denis-en-bas, Que.

SUMMARY:—Influence of Climate on Insects, Those Insects affected by Climate in Eastern Quebec, e.g., Apple-tree Tent Caterpillar, Forest Tent Caterpillar, Striped Cucumber Beetle, Potato Beetle, Striped Blister Beetle, White Marked Tussock Moth, and the Pea Aphis.

Influence of Climate:

"The Quebec Society for the Protection of Plants from either Insects or Fungous Pests" has as its object the study of the economic and noxious insects and fungi. One of the principal points to be observed about these is the effect that the climate of our locality may have on their life, development or destruction. I have made a special study of this phase of the subject in the Eastern part of the Province of Quebec where I live, and I wish to-day to present to the Convention the few notes I have made from my observations of their behaviour during the past thirty years.

List of Insects:

Appended is a list of the insects which I have observed as being particularly influenced by the varying climatic conditions of Eastern Quebec. I give the Scientific, Common English and French names to facilitate the reader in identifying them.

Latin	English.	French.
Anasa tristis.	Squash Bug.	Punaise des courges.
Clisiocampa americana.	Apple-tree tent Caterpillar.	Chenille à tente du pommier.
do sylvatica.	Forest tent Caterpillar.	do des bois.
Diabrotica vittata.	Striped Cucumber beetle.	Barbeau barré du concombre.
Doryphora decem lineata.	Potato beetle.	Chrysonile de la pomme de terre.
Epicauta vittata.	Striped blister beetle.	Cantharide barrée.
Hemerocampa (Orgyia) leucostigma.	White Tussock Moth.	Houppe à taches blanches.
Nectarophora destructor.	Destructive Pea Aphis.	Puceron destructeur des pois.

Anasa tristis.—We have had in our district three or four invasions of this insect which attacks pumpkins and squash. A specially bad attack occurred in 1886. This insect does not seem to occur for two consecutive years. If present one season it is usually absent the following season.

Clisiocampa americana.—This insect enemy of orchards was found abundantly and occupying a wide range in 1897 just one year after its great invasion of the orchards of Western Quebec. In the winter of 1908, we had to destroy many egg clusters on the branches of our apple trees. A few caterpillars were seen scattered here and there below Quebec during the summer of 1898 but since thence it has not been troublesome.

Clisiocampa sylvatica.—We have now and then the occurrence of these caterpillars in the woods particularly upon the chokecherry. But it never remains for more than a single season at a time. It is evident that the few we see every fifth or sixth year are wandering immigrants from the west which are unaware of the severity of our climate. They seldom are seen in orchards.

Diabrotica vittata.—This insect, which has proved so destructive to cucumbers in many districts, was recorded only twice in twenty years. in Eastern Quebec, appearing on both occasions in July and disappearing at the end of August. None have been seen for over ten years.

Doryphora decemlineata.—This beetle made its first appearance below Quebec in the year 1881. During the following year it was the cause of great damage and loss owing to the farmers being slow in adopting ways and means of combating it. Since the general use of Paris green against it, one can everywhere see throughout the counties of Kamouraska and Charlevoix and along the shores of the St. Lawrence where the water is salted that the beetle has almost entirely disappeared.

Many of the larva buried in the soil in the fall die there, and most of the beetles we see in the spring arrive late, and evidently come from localities situated further inland. In fact, we now use very little Paris Green. During such years as the present none was used.

Hemerocampa (Orgyia) leucostigma.—Each year we have found in our orchards a few dozen Tussock Moths. but in 1906 they invaded this locality in large numbers. Hosts of them attacked and damaged the trees of the orchard by almost totally defoliating them and the gnawing also of the fruit. In the late fall cocoons laden with eggs were to be found everywhere in such numbers that to endeavour to destroy all was out of the question. It was felt that the following spring must bring an even greater army of these caterpillars. To our astonishment, only a few dozen were seen during the summer of 1907, although in the spring of the year many half grown larva were seen. Some were half dead and others completely so. Since then none have appeard worth speaking of.

Nectarophora destructor.—This Pea louse, which is probably the largest of Aphids, made its appearance on our Sweet Peas in 1902. After an absence of about two weeks in July I found, upon my return, that a row of sweet peas which had been left in the best possible condition, was all dried up and rusted. Upon examining the lower parts of some plants which still had a few green leaves remaining, large green lice were observed which only too clearly indicated the fate of the other plants. These proved, upon examination, to be nectorophora destructor. This was the first and only time that I have seen it; although the peas were carefully watched the following summer no traces of them were found.

Conclusion.—It is felt that some will undoubtedly remark that I have given no proof that the climate of this eastern part of Quebec was responsible for the disappearance or unhealthy development of the insects above mentioned. These noxious insects are often preyed upon by many species of parasites which follow in their wake and wage war upon them. However, I observe that usually these parasitic insects appear only after the noxious forms have existed in a locality for a period of at least two or three years. Now, in the case of the eight insects I have mentioned, it is only the Potato Beetle that has been with us for any length of time. I therefore believe that the reason for the sudden disappearance of these insects was in some way connected with the severity of our climate and will continue to do so until I find, or am shown, some more plausible cause.

A STEM ROT DISEASE OF POTATOES.

(Corticium vagum, B. & C. var. Solani, Burt)

W. Lochhead, Macdonald College.

A Stem Rot Disease of potatoes, known formerly as **Rhizoctonia** from its characteristic sterile mycelium which forms no spores, was quite severe in some localities in the Province. The writer had the disease under observation in the potato plots at Macdonald College, and was able to study some of the characters of the sterile form.

This disease is known in different countries as "Black Rot," "Little Potatoes" and "Stem Rot." It has been reported from Europe and from many States of the American Union, particularly of the Middle West, and is capable of doing much damage. It attacks the stem below the surface of the ground destroying the bark and frequently completely girdling the

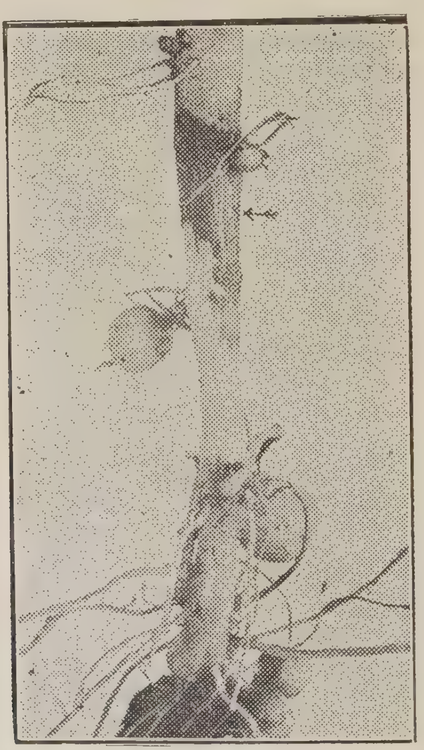


Fig. 1—"Little Potatoes" on a stem attacked with Rhizoctonia.

stem. When the disease has not entirely destroyed the tissues of the stem the sap may ascend to the leaves where plant food is manufactured as in the normal plant, but the return current is prevented from passing down beyond the dead blackened area. As a result, small tubers form above the injury (Fig. 1).

It is an easy task to pick out in a field the potato plants that are diseased. Such plants have not the bright green colour of the unaffected healthy plants and are not so thrifty and strong. In severe cases of attack the fungus has the habit of a damping-off disease.

Some observers are of the opinion that this fungus is not responsible for the production of the little potatoes that form above the injured area, but, so far as could be ascertained, during the past season no other fungus was present (Fig. 2).

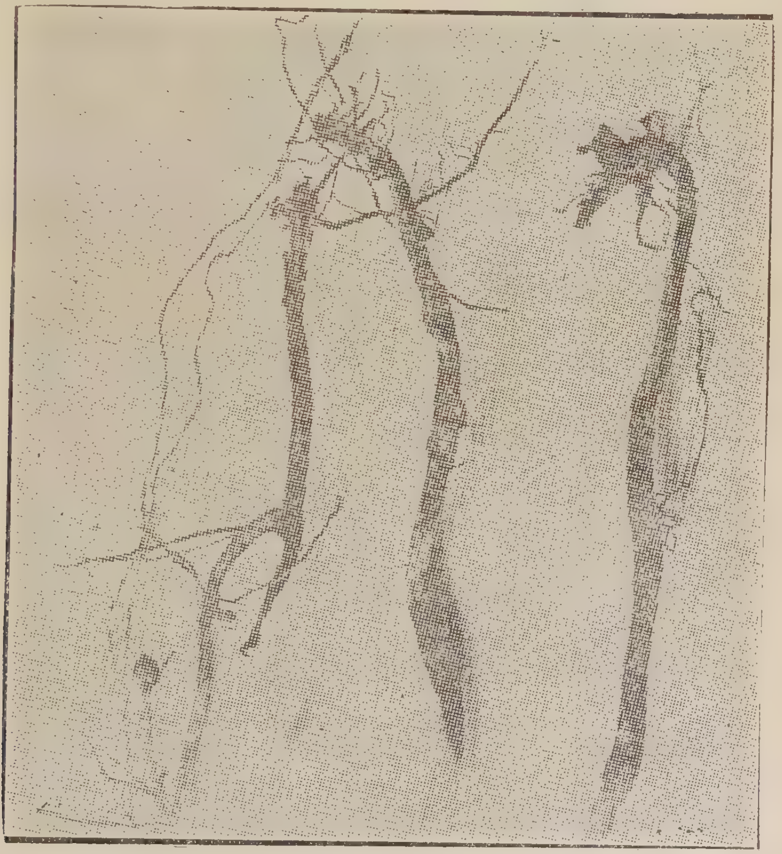


Fig. 2—Rhizoctonia disease of Potatoes. Photograph showing the black dead areas on the stems and the formation of tubes above the affected area.

The disease winters over on the surface of tubers as black spots called **Sclerotia.** These become very evident when affected tubers are washed under running water. On examination, the sclerotia are seen to be composed of dense masses of mycelium with threads of a characteristic shape. The threads are much branched, often irregularly; often breaking off into short lengths of one cell or more; the cells are short and are much constricted at the ends (Figs. 3 and 4).

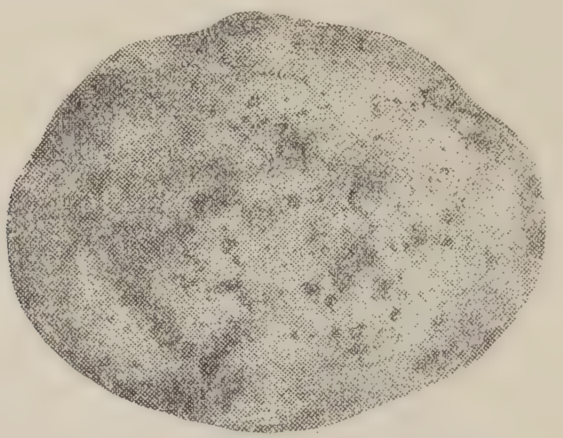


Fig. 3—Tuber of Potato spotted with black Sclerotia of Rhizoctonia.

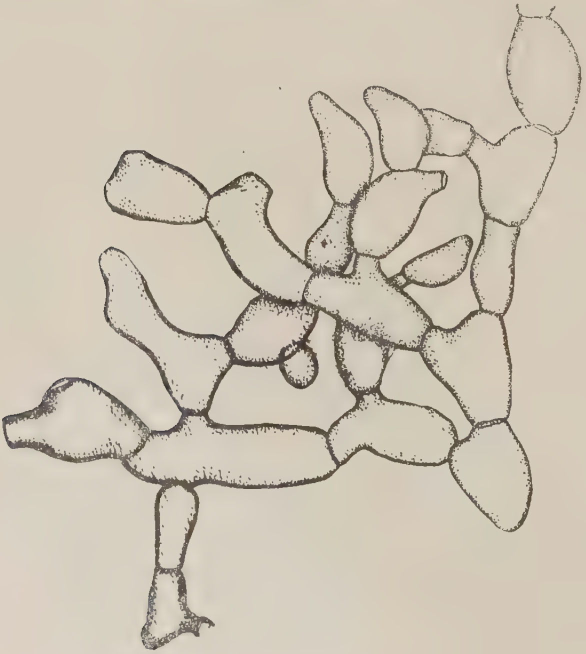


Fig. 4—The large, closely septate hyphae which make up the short tufted growth of Sclerotia.

When tubers with sclerotia attached are planted, the dormant threads of the sclerotia grow rapidly and branch in all directions. These branches are able to attack the living tissues of the young stems and set up a decay already noted.

An examination of many hundred plants in the field showed in every case of injured stems the presence of sclerotia and the mould-like growth of the mycelium on the tubers. We were unable to find the fruiting stage of the fungus, but such has been observed upon living plants as "a membranous layer enclosing the stem for several inches above the surface of the ground. This layer is composed of rather loosely interwoven threads, and on account of this character it is difficult to say if the plant is properly placed under the genus Corticium, or whether it might not with equal propriety be considered a species of Hypochnus" (Duggar).

Forms of Rhizoctonia allied to the one found on potato have been observed on sugar beet, bean, carrot, cabbage, garden pea, lettuce, pumpkin, radish, tomato, watermelon, and upon many species of ornamental plants and weeds.

Treatment.—The only available remedy is to treat the "seed" potatoes with formalin as for scab. It is also not advisable to grow potatoes two years in succession on the same soil, for tubers left in the soil may inoculate healthy seed tubers of the following season. Moreover, the use of barnyard manure tends to the development of the fungus, while the presence of lime retards to all appearances the growth of the fungus.

FERTILIZERS AND DISEASE.

H. S. Hammond, Macdonald College.

One of the most important effects upon plants of an excess of nitrogen is their increased susceptibility to fungoid attacks of all kinds; for example, rust is always much more abundant upon wheat which has been heavily manured with nitrogen, just as it appears on normally matured wheat whenever the character of the season has been such as to induce a specially rapid production of nitrates while the plant was making its growth, as when great heat and moisture come together in May. In seasons when rust is prevalent the high nitrogen plots at Rothamsted are always markedly the more rusty, and can easily be picked out by their colour; the grass plots are also marked by their special rusts; and again, such a characteristic grass fungus as Epichiloe typhina is generally common enough on the high nitrogen plots but absent from the others. But susceptibility to disease brought about by an excess of nitrogen is perhaps most strikingly seen at Rothamsted on the mangold plots, though the mangold is a plant which, as a rule, suffers but little from fungoid attacks. In September, however, the leaves of the mangolds at Rothamsted that receive an excess of nitrogen begin to be attacked by a leaf spot fungus, Uromyces betae, which develops rapidly until on the worst plots all the larger leaves turn brown and present a burnt-up appearance, because the spots of destroyed leaf tissue have become so numerous as to run together. Where the application of nitrogen has been less heavy but is still high, the severity of the attack is diminished, while the fungus is entirely absent from the leaves of the normally matured plots, although they are in close proximity and equally exposed to infection. The association of high nitrogenous manuring with susceptibility to disease may be seen in all plants; it is often very manifest in greenhouses where crops are grown in specially rich soil, nitrifying very rapidly owing to the high temperature prevailing. The dark green aspect of the leaves of such plants is generally evidence of the excessive amounts of nitrogen they are receiving, and it is well known that if any fungoid disease makes its appearance it is very difficult to keep in check and often destroys the whole crop with great rapidity; as, for example, with the leaf spot fungus Cercosporium melonis, which has, of late years, proved so destructive to cucumbers grown under glass.

Various attempts have been made to get a little nearer to the cause of this association of high nitrogenous manuring with susceptibility to disease. In the first place, certain physical differences can be traced in the tissues of the plants; just as high nitrogen results in a weakness of straw in cereals, due to a long-jointed soft stem, so the cuticle of the leaf and the cell walls of the leaf tissue are measurably thinner when the plant has been grown with an excess of nitrogen. The cause is, however, more probably to be found in some alteration in the composition of the cell sap, which renders it a better medium for the growth of the fungus in question. It has been found, for example, that spores of the Uromyces betae will grow freely upon a bruised surface of the mangold leaves grown with excess of nitrogen, but make no headway when sown upon a similarly bruised surface of the leaf of a normally matured plant.

The softness of tissue that is induced by large applications of nitrogenous manure—most markedly by nitrate of soda, because of its immediate availability—is recognized in other ways; for example, cabbages and similar vegetables grown rapidly with nitrate of soda are preferable for immediate consumption because of their tenderness, but in the market they bear a bad reputation, because the same softness of tissue leads to rapid wilting and a faded appearance when the vegetables have been cut for some time and have experienced the usual amount of rough handling in transit.

Potash.—On the grass plots at Rothamsted another striking effect of potash manuring is also very manifest. On the potash-starved plots the grasses fail to a large extent to develop any seed, and the heads are soft and barren, presumably because of the deficiency in carbohydrate formation. For the same cause the straw, not only of the grasses, but also on the similarly manured wheat and barley plots, is always weak and brittle when potash is wanting. The plants of the potash-starved plots at Rothamsted are always characterized by certain other appearances, which to a less degree are to be observed in nature where the soil is naturally poor in potash, as on many peaty and sandy lands. The grass has a dull colour, partly due to a deficiency of chlorophyll and its substitution by a certain amount of a red colouring matter along the stems, and partly because the tops of the grass blades show a great tendency to die off for an inch or two and leave a brown withered end. When, in 1908, the mangolds on the Barn field were replaced by Swede turnips, they grew with considerable vigour and remained perfectly healthy, but on the potash-starved plots the leaves in the autumn showed a flecked appearance, especially towards the margins, where a good deal of the leaf tissue had a yellow brown papery look which marked off the whole plot very distinctly, especially after the first frosts had taken place.

There is abundant experimental evidence to show that potash makes the plant more resistant to the attacks of fungoid diseases. It has already been explained how susceptible the use of nitrogenous manures renders the mangolds on certain of the Rothamsted plots to the attack of a leaf spot fungus—Uromyces betae. The attack is, however, much less severe on the plots receiving an abundant supply of potash; there, the plant remains healthy even though the nitrogen is in excess.

Just in the same way, the wheat on the potash-starved plots is always subject to rust, even in a good season when very little is to be seen on the other plots normally manured. The grass also on potash-starved plots is attacked by various fungi; hence it may be taken as a general rule, that crops which do not receive their full supply of potash will be correspondingly susceptible to disease.

It is not possible to say whether this is due to any specific alteration in the composition of the cell contents or to a general lack of vigour, but the latter is probable, because an excess of potash tends to prolong the vegetative growth of the plant and to delay maturity. Plants receiving potash are always a little the greener, especially late in the season, and this is not always an advantage, as may be seen from the fact that the barleys grown on the plots receiving potash at Rothamsted, show a somewhat darker and less attractive colour than those grown without potash. That potash tends to prolong growth may also be inferred from the fact that its effect upon the yield is always most pronounced in dry seasons.

In the dry season of 1893, the yield of barley (grown also with ammonium salts and superphosphate) was increased by a dressing of potash from 18.1 to 30.8 bushels per acre, whereas in the wet season of 1894 the increase was only from 34.9 to 41.4 bushels per acre.

Similarly with the wheat in the wet season the application of potash only increased the yield of grain from 11.1 to 16.0 bushels, and the weight from 54.6 to 57.8 lbs. per bushels; whereas in the dry season the yield was increased from 7.7 to 16.4 bushels (more than double), while the weight was raised from 56.4 to 62.6 lbs. per bushel. That the bad results in the dry year were due to a premature ripening of the plant, which was deferred by the potash, is seen from the fact that with potash the ratio of grain to straw was 98, whereas without potash it only reached 67.3, in which case the migration of materials from the straw to the grain is clearly incomplete. But though in such cases of grain crops the use of potash prolongs the development of the plant and defers maturity, apparently an opposite effect is produced upon root crops. On the Rothamsted field, for example, where potash is used, the mangold leaves will begin to turn yellow and fall, indicating that the plant has finished its season's growth, long before any such appearance is seen on the potash-starved plots alongside, where a tuft of dark green and apparently growing leaves persists until the plant is cut off by the frosts. Similar appearances, though in a less pronounced degree, can be seen on ordinary crops in light soils, whenever a strip has been left to show the action of potash in the manure.

The apparent contradiction may be explained on physiological grounds; with the root crops ripeness does not represent the completion of a migration process of material previously stored up, such as takes place from straw to grain, but marks the completion of the work of the leaves in manufacturing carbohydrate and passing it on to the root for storage. In the absence of potash the leaves cannot carry on the assimilation process properly, and probably they continue green instead of ripening off because their function of storing up material in the root has not been completed.

From time to time field experiments have been reported which show a reduced yield for the use of potassic salts, and while in many cases the results might be put down to experimental error, the cases are too numerous to be entirely covered by such an explanation.

A clue to this apparent depressing effect of potash is provided by the appearance of the soil on certain of the experimental plots at Rothamsted, as on the Barn field, where considerable amounts of potash salts are applied every year. The behaviour of the soil, which lies extremely wet and sticky after rain, and dries with a hard glazed surface, shows that the clay particles must have become thoroughly deflocculated, just as they are on the plots receiving nitrate of soda (p. 55).

This deflocculating effect of the potash salts, which in themselves would flocculate clay particles, is due to a prior interaction between the potassium salt and the calcium carbonate in the soil, resulting in the formation of a certain amount of potassium carbonate, the deflocculating powers of which are recognized.

The destruction of tilth of the soil brought about in this way may easily give rise to an irregular stand and so account for an inferior plant and a reduced yield on the plots receiving potash salts; the author has observed a case on heavy land where the application of a rather excessive amount of kainit so altered the texture of the soil, that the draught of ploughs upon it was perceptibly increased, and the crop suffered to a marked degree.

Farmyard manure has frequently been blamed for carrying the seeds of disease and of weeds which have passed through the animals making the dung in an unchanged condition and thus contaminate the land for other crops. When bullocks have been fed Swedes affected with "club-root" and the uneaten fragments of the roots have been thrown among the litter, the spores of the disease have been found to live unharmed through the making and rotting of the manure, so that fresh land may thus become infected when the dung is carried on to it.

Club-root.—On many soils, particularly those of a sandy nature, the turnip crop is often almost wholly destroyed by the disease known as "club-root." Cabbages and other cruciferous crops are equally attacked; so much so that in gardens which have become infected it is practically impossible to raise crops of this nature. The disease is caused by an organism, Plasmodiophora brassicae, belonging to the slime fungi and forming spores which may remain dormant in the soil for some time, certainly for two or three years. It has long been known that the best remedy against club-root consists in the application of lime, and as far back as 1859, Voelcker showed that soils on which this disease is prevalent are deficient in lime, and in many cases in potash also. Later researches have only served to emphasize the fact that the disease is associated with soils of an acid reaction, in which calcium carbonate is wanting, or present in very small proportions. The fungus, as is generally the case with fungi, refuses to grow in a neutral or slightly alkaline medium, and the only way to get rid of the infection in the land is to restore its neutrality by repeated dressings of lime. At the same time, the land should be rested as long as possible from cruciferous crops; uneaten fragments of diseased turnips, etc., should not be allowed to go into the dung, or if they do, the dung should be used on the grass land. Manures, again, which remove calcium carbonate from the soil, like sulphate of ammonia, or acid manures like superphosphate, should not be employed; neutral or basic phosphates, with sulphate of potash on sandy soils, should be employed instead.

The following figures show the amount of lime dissolved by hydrochloric acid from soils affected with "finger-and-toe," as compared with spots in the same field where the disease was not in evidence:—

	LIME PER CENT.				
	Voelcker.	Voelcker.	Hall	Sandy Soil.	Clay Soil.
Soils affected by disease........	.14	.084	.13	.31	.39
Soils free from disease..........	.89	.52	.43	....	....

It must be remembered that in these cases the total lime soluble in acids is given, not merely the lime present in carbonate.

Whenever a turnip crop is seen to be infected with "club-root," the land should be well dressed with 3 or 4 tons per acre of quicklime immediately the crop has been removed; as long an interval as possible should be given before again taking a cruciferous crop, substituting, for example, mangolds for turnips in the next rotation; every effort should be made to destroy cruciferous weeds like charlock; turnip-fed dung should not be applied, and another dressing of finely divided quicklime should be put on for the crop preceding the sowing of the new turnip crop.

While it has been indicated that many plants are intolerant to lime, others show the effect of any excess in the soils by a stunted development of the plant, often accompanied by a reduced size of the leaf, and a sickly yellow or even white colour. This unhealthy condition of "chlorosis" is particularly noticeable on the stiff marls, which are but little aerated but contain much calcium carbonate; in Europe it often affects vines, particularly when grafted on American stocks.

THE CARROT-FLY.

J. C. Chapais, St. Denis.

Hæc nugæ seria ducent in mala—Hor. A. P. 451.

(*These trifles will lead to serious mischief.*)

SUMMARY—A Word on Behalf of Entomology.—The Carrot-Fly.—Classification.—Description.—Depredations.—Remedies.

A word on behalf of Entomology.—Amongst all the branches of natural history, Entomology is certainly the most pleasant and the most attractive to study for anyone who has a sense of observation. Even from a scientific point of view it offers a very great interest, when we put ourselves in the presence of those minute beings which, though they seem very small and powerless, are gifted with an invincible strength, due to their union in innumerable numbers which scramble over the world, overthrowing structures, sinking vessels, preying upon plant life, falling even upon man and making away with him sometimes before he is aware of their presence.

But, if we consider Entomology as a science which gives man an acquaintance with those obscure enemies, to detect the secret of their life, of their metamorphoses, of their methods of ill-doing, and enables him thereby to fight efficaciously against them, then, this branch of natural history, instead of being only a speculative science, becomes one of the greatest utility, of which everybody ought to know at least the rudiments. I have never made any study of it otherwise than from this latter point of view. I value more highly the knowledge I have acquired by its study than by any other means. It is owing to that knowledge acquired under the spur of necessity that I am now able to speak for a short time about a small insect to which we may well and justly apply the sentence from Horace which I have selected as an epithet to put at the head of this short article.

The Carrot-Fly.—This small insect though well known for a good while and studied in every detail by many distinguished entomologists such as Fletcher, Ormerod and others, is very little known by many of those who suffer the most from its depredations. It is for that reason that I come here to-day to talk about it with the members of the Quebec Society for the Protection of Plants, to enable this society to popularize the knowledge of this small destructive insect by means of the distribution of its next report.

Classification.—We will begin by getting well acquainted with the various names under which the Carrot-Fly is known, and then we will give the indication of the place it occupies in Entomology.

English names.—Carrot-Fly, Carrot Rust-fly.

Scientific Latin name.—Psila rosæ, Psilomyia rosæ.

French name.—Mouche de la carotte.

Common French name.—Mouche a Carotte Manille.

The Carrot-Fly is described as follows in its classification: **Species, Psila rosae; Genus, Psila; Family, Psilidae; Order, Diptera; Class, Insecta;**

Phylum, Arthropoda.

Description.—The Carrot-Fly is about a quarter of an inch in length and not quite half an inch from tip to tip of wings. Its narrow body is of a metallic dark green, almost black; the head is round, of ochre color; the eyes are red; the legs are ochre yellow. The wings are iridescent and marked with ochre colored veins. The female has a long retractile ovipositor, through which it deposits its eggs. The larva is easily identified. It is a kind of a little apodous maggot, slim in shape, about a quarter of an inch long, white or yellowish, shining, with a very small head furnished with two black horny hooks with which it tears up the pulp upon which it feeds. The posterior part of the body is truncite and rounded and has two small black spiracles looking like two little horny tubercles. When the larva are fully grown, they burrow into the soil and turn to pupæ. The puparium is cylindrical, shining and has a ferruginous or ochre-colored tint.

The nymphal stage, in the course of the summer season, lasts three or four weeks; but, if the transformation occurs in the fall of the year, the pupæ winter and the flies come out from them only in the following spring. There are two generations in one season.

Depredations.—Now that we are well acquainted with this foe of the carrot. we will try to make out how it works injury to the plant it infests.

We had a serious attack of this insect in our gardens below Quebec, about fifteen years ago. But its depredations lasted only two years, and now, it has reappeared during the last two years, being the cause of serious damage, specially during the past summer (1909). This has decided me to publish the present short article so that our gardeners may act in cooperation to fight against it before it is too widely distributed.

As to the way in which the **Psila** makes its attack, I find a slight difference of opinion between a contribution to "Le Journal d'Agriculture pratique de France," whose name I don't know, and Miss Ormerod, quoted by the regretted late Dr. Fletcher. The French contributor says: "The female has a pretty long and retractile ovipositor through which it deposits its eggs at the collar or neck of the plants." On her side, Miss Ormerod says: "To present the attack in general, the necessary thing is to have the soil well prepared which allows the plant to grow rapidly and which is not subject to crack; then, at thinning time, we must see that no opening is left through which the fly could penetrate to the root and deposit there its eggs. **If the fly cannot reach the roots to deposit there its eggs, it is understood that they will contain no larvae,** and the reason why some carrots which thrived till thinning time run to waste afterwards comes often from the fact that, at thinning time, the soil was opened."

As I have just read, one says that the fly deposits its eggs **at the collar or neck of the plants,** the other says that it deposits them **on the roots.** I confess that my own observations on this subject did not go far enough to enable me to decide who is right. In doubt, by what is written farther below, it is better to suppose that Miss Ormerod is on the right side.

Here is what she says on this subject: "The carrot-fly, when she is ready to lay her eggs, looks for a crevice or crack near the carrots, in the soil, and there it deposits its eggs either on the carrots or near by. The small yellowish or whitish larvae which hatch from the eggs penetrate into the root itself or, if this root is very small, they destroy its interior part. The grubs may be found in winter as well as summer, and attack all parts of the carrot root by gnawing galleries on the surface, or in the substance of the root; but whilst the roots are young, the grubs seem generally to attack the lowest part. If infested carrots are carefully drawn from the earth, the grubs will be seen on the root, sticking out of their burrows by about half their length. The attacked carrots may be known by the outer leaves turning yellow and withering, while the roots gradually sicken and die from the injury to the fleshy part, the growth of the root fibre being also often completely destroyed."

On account of the fact that all the parts of the infested carrot take a uniform color of rust very marked and that, by many of those who look at these discoloured carrots, the insects are not found has suggested the belief that this disease is really a kind of "rust," which explains why we hear more of the "carrot-rust" than of the "carrot-fly."

Remedies.—1. When the young carrots are sufficiently grown to be thinned, it is well, if possible, to do the thinning towards the end of the day, and to apply immediately on the rows some of the petroleum emulsion of which the formula is here given:—

Petroleum (coal oil), 2 gallons; rain water, 1 gallon; home-made soap, ½ pound.

Boil the soap in the water so as to dissolve it; pour that solution in the oil and stir briskly the whole together for five minutes in order to make a creamy emulsion. Mix one part of this solution in nine parts of water and sprinkle on the rows.

2. Instead of the petroleum emulsion, one may use the following remedy: Incorporate by mixing it well with half a pint of petroleum in three gallons of sand, well pulverized land plaster or ashes, and sow this mixture on the rows of young carrots just after thinning.

3. You may also use, instead of petroleum, some crude Carbolic Acid prepared as here indicated: Boil one pound of home-made soap in one gallon of water so as to dissolve it, pour in that solution one pint of carbolic acid. Boil the whole together for a few minutes, all the while stirring briskly. Dilute one part of this solution in fifty parts of water and use it to sprinkle the young carrots as has been indicated for the petroleum emulsion. It is with this remedy that I have had the best success.

4. Instead of the carbolic acid emulsion, the following remedy may be used. Incorporate, by mixing well, one pint of carbolic acid in fifty pounds of land plaster, sand or ashes, and sow this mixture on the rows of young carrots, just after thinning.

An application of one of these four remedies just indicated should be made once a week, during June and July.

5. Late sowing of the carrot seed is of some advantage and, as that seed may be sown rather late in June and still yield a good crop of table carrots, it is well to make two or three sowings at ten days' intervals, then we may be sure that at least some parts of the crop will come out clean.

6. Common sense suggests that carrots should never be sown two consecutive years on the same piece of ground or near a piece of ground which has just been infested by the carrot-fly.

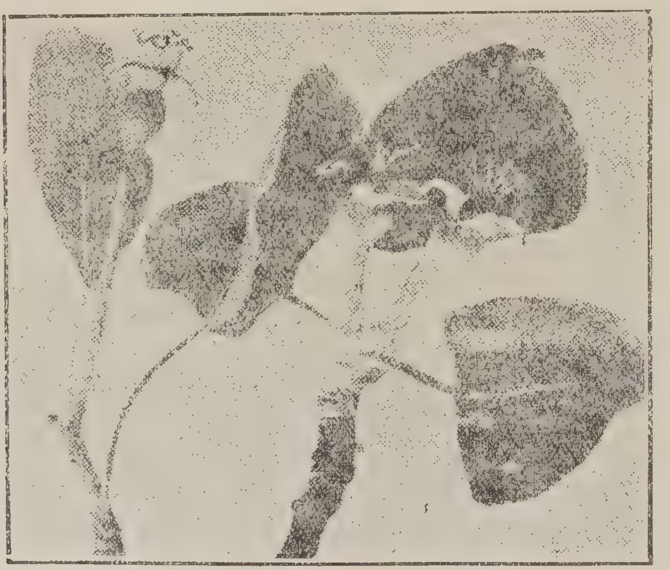
7. When carrots are kept in the cellar in sand, during winter, the larvae leave the roots and turn to pupae in the sand. In the spring of the year, this sand should be taken away with great care and buried in a hole at least three feet deep in order to prevent the pupae from emerging.

INJURIOUS INSECTS OF STE. ANNE'S, SEASON OF 1909.

By J. M. Swaine, Macdonald College.

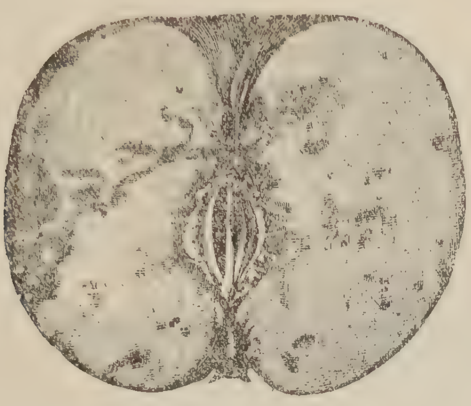
Very few reports of insect injuries have been received by the Secretary, and these few notes refer mainly to the district about Macdonald College. It would help the Society in its work if the farmers, and others interested in pests and diseases of plants, would send specimens and reports of such to the officers of the Society, to the directors, or to the Secretary, or to the Biology Department, Macdonald College.

The Codling Moth (Carpocapsa pomonella Linn), has been as injurious as usual in unsprayed orchards. Poisoned Bordeaux applied thoroughly in a fine spray once just before the blossom buds open, and again within ten days after the blossom petals drop prevents eighty per cent. of the injury from the Codling Worm and largely insures against the scab. The application should be repeated if heavy rain occurs within twenty-four hours.



Just right to spray. A pear and two apples from which the petals have recently fallen. Note that the calyx lobes are widely spread. Spraying time for Codling Moth. (After Slingerland.)

The Apple Maggot (or Railroad Worm) does not appear to be spreading. The only remedy lies in destroying all windfalls as soon as they drop, so as to kill the contained maggots. Windfalls may be gathered each day and either boiled and fed to stock, or buried in a pit and covered with lime and **over six inches** of earth. The maggots leave the fallen apples to pupate in the ground.



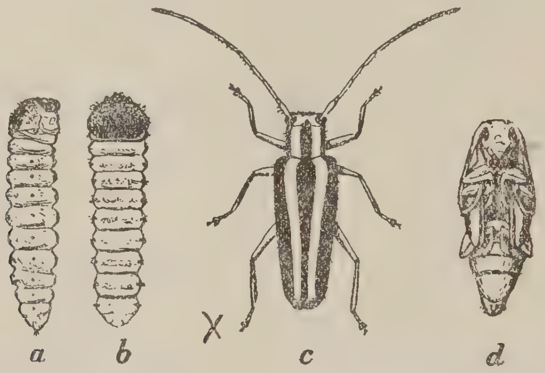
Fruit injured by the Apple-Maggot (Trypeta).

Experiments have been made to bury the pupae so deep by plowing that the flies which emerge from the pupae would be unable to reach the surface. It was found that the flies would find their way through five or six inches of earth, so that there is probably little benefit from plowing.

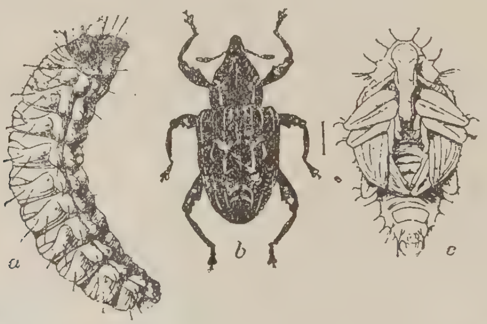
The Plum Curculio has not been so injurious in the localities known to me as in some previous years, though plums and apples in some places suffered severely. In controlling this beetle on apples and plums the chief dependence should be on poison sprays. The regular spraying with poisoned Bordeaux, using lead arsenate in larger amount, combined with rigid destruction of fallen fruit is the best practice. Jarring has some place in protecting choice fruit on small apple trees and is valuable in protecting plum trees. When the beetles are numerous they can be removed from small trees by jarring the trees in the early morning with a padded mallet over a white cloth spread beneath the branches. The beetles which drop should be gathered and burned or killed in coal oil.

The practice recommended by some, of keeping a few plum trees as fillers in the apple orchard to serve as traps for the curculio seems to me a good one. The curculio has not, until the past season, injured the apples of our College orchards, although they have bred each year in great numbers in the plums of two old plum trees in a corner of one of our apple orchards. In the past season the plums on those two trees failed completely and the apples on the neighboring trees **only** were badly injured by the beetles. In this region at least the curculio much prefers the plum to the apple, and a few plum trees in the apple orchard would attract the majority of the beetles present. The wormy plums from these trees should, of course, be completely destroyed.

The Apple-tree Borers (Saperda candida and Chrysobothris femorata) were locally injurious, as usual.



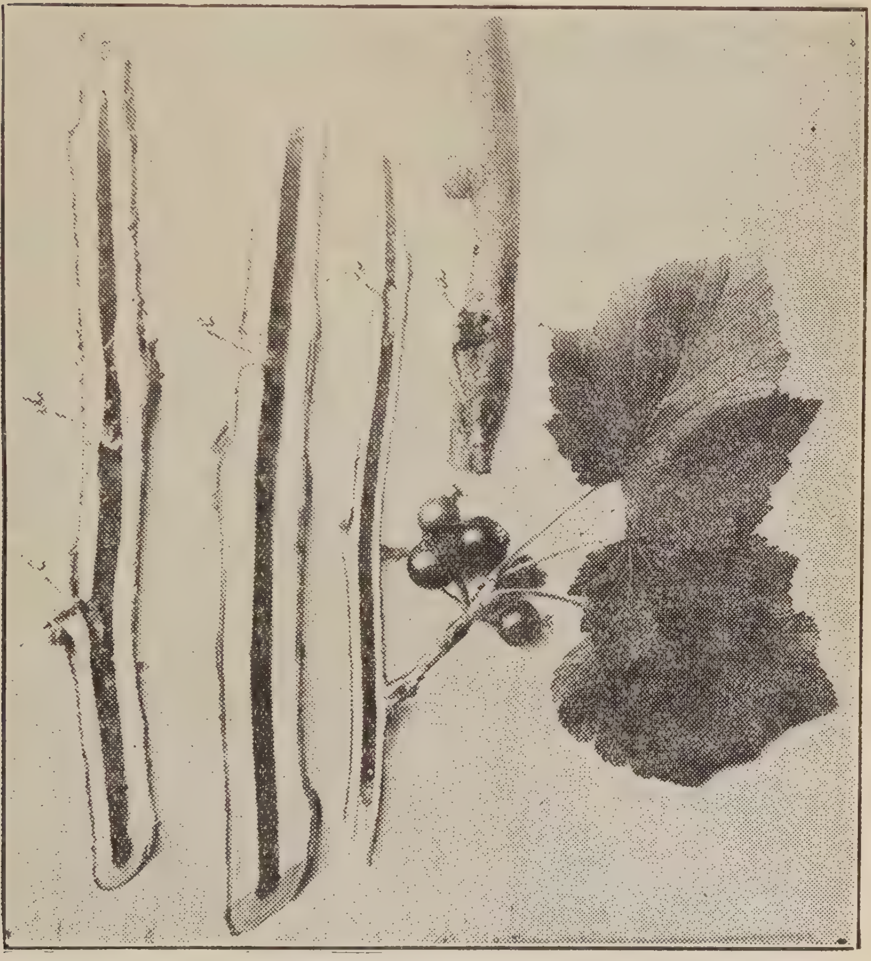
The Round-Headed Apple-Tree Borer (Saperda candida Fab.): a, larva, from side; b, from above; c, female beetle; d, pupa—all enlarged one-third. (From Chittenden.)



The plum curculio (Conotrachelus nenuphar); a, larva; b, adult; c, pupa. Much enlarged (hair line to right of b indicates natural length of adult). (From Chittenden.)

The Bud Worm, the **Case-bearers**, and the **Canker-worms** have not been injurious in this neighborhood. **The Apple Aphis** caused less trouble at the College than usual. The trees were thoroughly sprayed early in the season with lime sulphur wash, and this, apparently, destroyed many of the aphis eggs.

The Currant Borer (Sesia tipuliformis L.), appeared suddenly in our currants last season and destroyed many canes, both in the black and red currants. The moths emerge late in May and June and early in July (two pupae were found July 9th) and lay their eggs at the buds on young wood. The caterpillar bores into the stem and down through the pith, leaving a black tunnel. It remains in the wood during the winter and continues operations in the spring. When mature the larva cuts an exit hole through the wood and pupates near the opening. The chrysalid often wriggles until



Work of the Currant cane-borer. a, exit-hole; b, larva; c, exit-hole; d, pupa; e, pupa projecting from the exit-hole.

it projects from the opening so that the adult can escape without touching the wood. Sometimes the tunnels extend into the main mass of the stem.

The injury is first noticed by the leaves of the affected canes wilting and turning brown during May. Such canes should be at once cut out and burned to destroy the contained larvae.

The American Currant Borer (Psenocerus supernotatus Say) a brownish-black beetle, about one-quarter inch long with white spots on the wing covers, at times breeds in currant canes. We collect it at Ste. Anne's from Virginia Creeper and Climbing Bittersweet, but it has so far left our currants. When it occurs the affected canes should be destroyed.

It is true in the case of these borers, as with many other insect pests, that nothing can be done to save the part attacked; the injury is effected before it is noticed. Destroying the insects, however, will prevent much of the damage that would otherwise result the next season.

The Currant Aphis (Mysus ribis L.), has been abundant in this neighborhood on untreated bushes. The more or less reddish, blister-like distortions of the leaves. caused by the feeding of the yellowish plant-lice or aphids, are common everywhere on currants. The productive power of the plants must be considerably checked when the insects are numerous. The best application is fish oil soap sprayed as soon as the trouble is noticed, before the leaves have curled badly. Curled leaves should be picked and dropped in coal oil to destroy the insects. Kerosene emulsion, tobacco decoction and soap solution are usually effective. An angled nozzle should be used and the under surface of the leaves thoroughly wet.

The Currant Span-worm (Cymatophora ribearia Fitch.) The yellowish moths of this species were very abundant about our currants and gooseberries in July. The eggs are laid during this month and later on the twigs, where they remain during the winter to hatch in the spring. The whitish yellow-striped looping caterpillars feed voraciously upon the leaves during June. They are more difficult to kill than the common Currant Worm and affected bushes should be sprayed with Paris green or lead arsenate, or the former may be applied dry while the leaves are wet with dew. Pyrethrum powder dusted with a powder gun is effective.

The Imported Currant Worm (Pteronus ribesii Scop.), always with us, is easily controlled with hellebore applied dry or as a spray. On large plantations, however, Paris green and lead arsenate are always used until the fruits are partly grown, after which hellebore is used if needed.

The Gooseberry Fruit Worm (Zophodia grossulariae Riley), destroyed a few berries. The small caterpillars feed within the berries, several of which they sometimes tie together with silk. They pupate beneath the surface of the ground in silken cocoons. The moths appear in spring. The only method of control is to gather and destroy the infested berries. Poultry, if allowed in the patch late in the season, would doubtless destroy many of the cocoons.

Mites, or Red Spider (species of Tetranychus.)—Myriads of tiny eight-legged mites are often found on the under sides of the leaves of raspberry and other small-fruit bushes. The mites spin a delicate web and cause a distortion of the leaf, both of which help to protect them from any spray. They breed with great rapidity in dry seasons and spread rapidly over the leaves, which if badly infested, curl, discolor, and finally drop. If it is found necessary to treat them in summer, kerosene emulsion carefully mixed, or fish oil soap sprayed thoroughly, will hold them in check. The under sides of the leaves should be well soaked. A thorough spraying with water is beneficial. Early in the season before the buds start the bushes and the ground at the base may be sprayed with strong lime-sulphur wash to destroy the hibernating form.

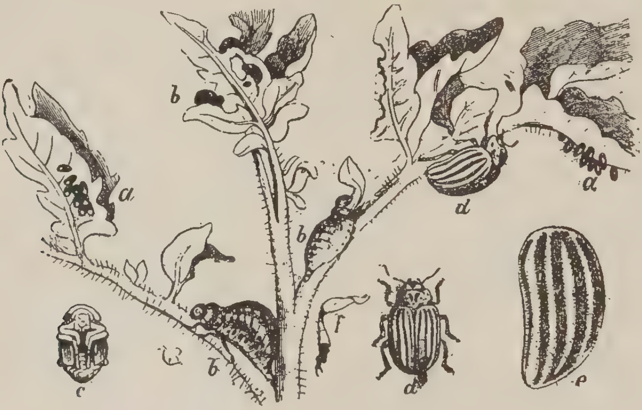
The Raspberry Cane Borer (Oberea bimaculata Oliv.), is always abundant, though its numbers may usually be much reduced by carefully destroying the wilting tips. The adult, a slender beetle with black wing covers and a yellow thorax, cuts two rows of holes about the twig shortly below the tip. Between these rows she inserts a longish yellow-white egg. The resulting grub bores between and above the rows of slits in the then wilted tip for a time, and later eats its way down the cane. The grubs remain in the canes during the winter and mature in the following spring. The wilted tips should be cut off and burned as soon as noticed. Late in the season the borers will be well down the stem and the whole cane should be removed. We have recently bred this or an undescribed species from apple twigs sent from Cambridge, N.B.

The other Raspberry insects were not noticed here in 1909.

Insects of Garden and Field Crops:

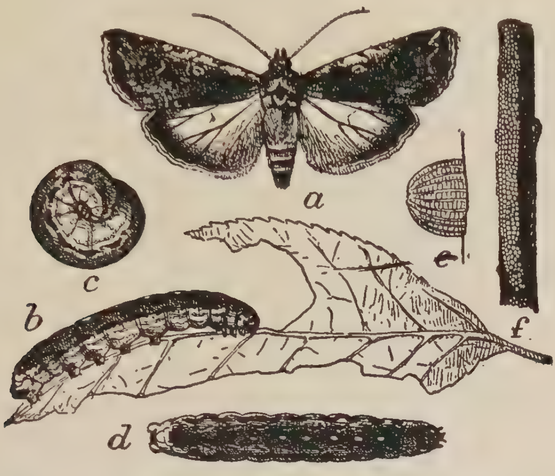
The Cucumber Beetle (Diabrotica vitatta Fab.) was very numerous last season. It prefers squash to other plants, and can be kept away from cucumbers and melons by having a few squash plants nearby to act as traps. The main crop should be kept covered with poisoned Bordeaux mixture, and the trap plants may be sprayed with kerosene emulsion or fish-oil soap, as often as they become covered with the beetles. Bordeaux mixture is distasteful to these beetles and is perhaps the best mixture for keeping them away. It should be replaced as fast as new leaves appear. In controlling these beetles on large fields of squash the best practice is perhaps to keep the main crop well covered with poisoned Bordeaux, and to reserve here and there, mainly about the edges of the field, a few plants to act as traps; these trap plants should be kept well covered with lead arsenate. Any fine dust, sifted ashes, lime or road dust, applied when the plants are wet, will drive the beetles away for a time. Many growers keep each young plant covered with cheese cloth until the first brood of beetles has disappeared (second week in July at Ste. Anne's in 1909), or have moveable cheese-cloth frames which will cover a number of plants.

The Colorado Potato Beetle exacted its customary tribute. Lead arsenate, 3 lbs. to the barrel, has proved most satisfactory here. Experiments carried on by Prof. Blair seemed to show that better results are obtained by applying this amount in two applications. Spray 1½ lbs. lead arsenate to the barrel and repeat with the same as soon as the first is dry. The beetles and egg-masses should be hand-picked early in the season, until the plants have enough leaf-surface to carry considerable poison.



The potato beetle; a, eggs; b, grubs; c, pupa; d, adult. (Copied).

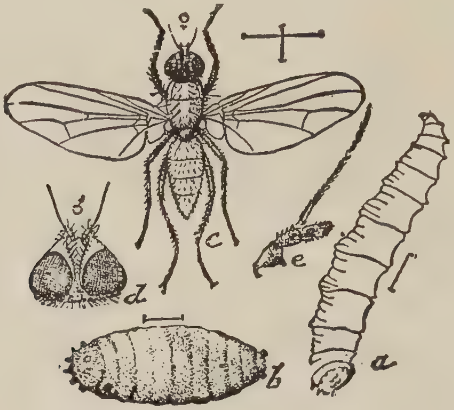
Cut-worms were more than usually destructive. Young carrots, beets and turnips suffered most severely. When taken in time cut-worms are, as a rule, easily controlled with poisoned bran mash scattered in the evening about the base of the plants. In our experience the dry bran is not eaten by the worms, hence it should be well moistened and applied late in the day. Cut-worms are stout, cylindric, usually earth-coloured caterpillars, larvae of Noctuid Moths. They remain hidden below the surface during the day, feeding upon tender plants at night. Many winter half-grown in the soil. If cut-worms are feared the poisoned bran should be scattered over the field, in the evening, at the time of planting. Most of the worms can be killed in this way before the plants are up.



Peridroma Saucia. a, adult; b, c. d, full grown larve; e, f, eggs. All natural size except e, which is greatly enlarged. (From Yearbook U. S. Dept. Agric. 1898.) Life-history of a cutworm.

Root Maggots.—Maggots appeared last season for the first time in our cabbages and onions and destroyed a small number of plants. The injury is caused by small maggots feeding in the root or bulb. There are two preventives which can be recommended for maggots in cabbages. Small discs of tarred paper or tarred felt, slit half way across and inserted and carefully packed about the plants at the time of setting, will effectually prevent the laying of eggs. The eggs are laid by the adult two-winged flies about the base of the plant, and usually as soon as the latter are in the field. The discs should go on when the plants are set. A strong mixture of hellebore or pyrethrum powder, 4 oz. to the gallon, driven in a strong spray about the roots of the plants soon after planting has proved effective with some growers. The earth should be at once replaced about the stems.

Dr. Fletcher's method of application was as follows:—"One person carried a 3-gallon pail full of water in which 2 ozs. of white hellebore had been steeped, and an ordinary greenhouse syringe, the other placing the left hand beneath the cabbage, palm downwards, with two fingers on each side of the stem, drew away the surface soil from the root of the cabbage, and at the same time with the right hand, pulled the head a little over, so as to expose the roots. About half a teacupful of the liquid was then syringed forcibly round the roots, and the earth was quickly pushed up again round the stem. The result of the treatment was that only about 1 per cent. of the cabbage was lost."



Cabbage Maggot; a, larva; b, pupa; c, adult. (Riley).

Sand barely moistened with coal oil placed closely about the base of the plants, immediately after transplanting, is often effective with cabbages, but must be repeated each week until the **middle** of July.

Carbolic acid emulsion is sometimes used with success. Hollow out the earth about the plant and apply plenty of carbolic acid emulsion diluted with thirty parts of water. Apply first just after plants are up or the day after they are set out, and repeat every week until the first of June.

For the Onion Maggot, the above spray with hellebore or pyrethrum powder is as effective as any I can suggest at present. Carbolic acid emulsion used in the same way is sometimes effective. It is sprayed along the rows once a week. Hellebore dusted along the rows once a week is sometimes effective on onions and radishes.

It has been recommended to pour thick whitewash along the rows as soon as the onions are above the surface, with the object of closing up all cracks and preventing the maggots from penetrating to the roots.

The same maggot works in cabbages, turnips and radishes, and these crops should be as far as possible from soil which has been infested the previous season. Onions should not be planted on land which contained the onion maggot the year before.

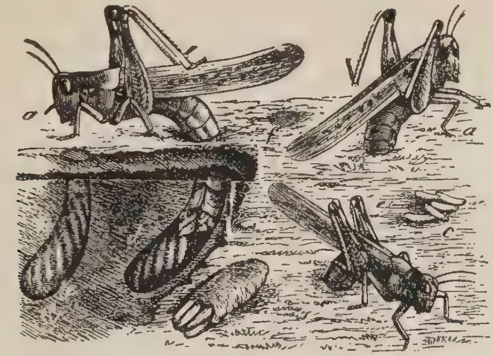
Tobacco dust applied liberally about the plants when set out or when just above the ground is useful. A quick-acting fertilizer, such as nitrate of soda, is beneficial. Remains of all maggot-infested crops should be rigidly destroyed, and rotation practised. When an excess of seed is planted a stand may be obtained even though many plants are destroyed.

From cabbages the first adults of the first brood appeared in the cages July 8th; from onions, July 20th; from soy beans, July 3rd; from cow peas, July 2nd; from turnips late in July.

Flea Beetles of several species feed on various cultivated plants. Very small, black, freely jumping species were common on turnips last spring, eating small round holes in the leaves. When these are very numerous young plants may receive a serious check. Like the Cucumber Beetle the Flea Beetles have a strong dislike for Bordeaux mixture, and will leave plants sprayed with it. Spraying with Bordeaux mixture is a practical preventive, and an application of a quick-acting fertilizer, such as potassium nitrate, may enable the plants to overcome the pruning of the beetles, without other treatment.

Aphides on Vegetable Crops.—Plant-lice were common on many crops, notably on cabbage and allied plants. These pests are controlled by a spray of kerosene emulsion or fish-oil soap, or tobacco decoction, when they become sufficiently numerous to demand attention. Remains of crops should be completely destroyed as soon as crop is gathered, else they serve as breeding places for insects throughout the fall.

Grasshoppers.—In many parts of the Province grasshoppers did a great deal of damage last season to grass and grain. At but slight expense the injury from this cause can be largely averted. The breeding places can be ploughed in fall or early spring, when this is feasible, and many egg masses so destroyed; the grass fields can be cleaned of the pests by means of the "hopper-dozer"; and the grain fields can be preserved by the use of



Grass-hoppers laying their eggs. (Copied).

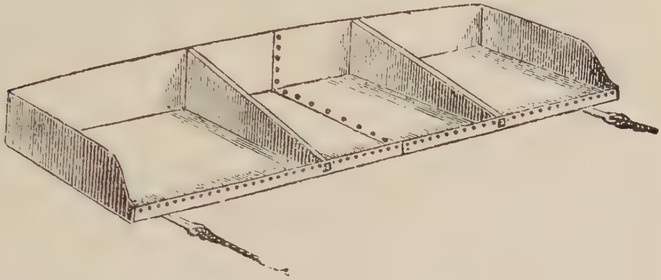
"Criddle-mixture." The females lay their eggs in the fall in packets, covered with a mucilaginous secretion, placed below the surface of the ground. Usually dry, upland pastures and fields are chosen. In the spring the eggs hatch into tiny, wingless hoppers which spread over the grass fields of the neighborhood. They eat voraciously, increasing in size at each moult, and gradually assume the form of the adult.

Grasshoppers are preyed upon by many enemies; birds particularly do fine service in keeping them in check, and should therefore be protected. During August grasshoppers form the staple diet of very many of our larger land birds.

Methods of Control.—If fall ploughing is otherwise desirable, it may be depended upon to reduce the number of the pests, but under most conditions is not very effective. The most effective method of control in grass fields is by use of a hopper-dozer.

Hopper-catcher or hopper-dozer.—These machines are of many kinds and have been used with great success in the West. The construction of two of the more simple will be outlined here.

"A good and cheap pan is made of ordinary sheet-iron 8 feet long, 11 inches wide at the bottom and turned up a foot high at the back and an inch wide at the front. A runner at each end, extending some distance behind, and a cord attached to each front corner, complete the pan, at a cost of about $1.50. We have known from 7 to 10 bushels of young locusts caught with such a pan in an afternoon. It is easily pulled by two boys, and by putting several together in a row, one boy to each outer rope, and one to each contiguous pair, the best work is performed with the least labor. Longer pans to be drawn by horses should have transverse partitions to avoid spilling the liquid, also more runners. The oil may be used alone so as to just cover the bottom, or on the surface of water, and the insects strained through a wire ladle. Small pans for oil, attached to an obliquing pole or handle do excellent service in gardens." (Riley). This machine can be made of wood, and tar or "tree-tanglefoot" can be used instead of the coal oil recommended. The tar or tanglefoot should be coated on the upper surface of the baseboard and the front of the upright which may be a frame covered with cloth; a fresh coating should be given as often as the hoppers completely cover the surface. Finally, the whole is shovelled off and burned. For use in rocky fields the machine can be raised on higher runners or on small wheels. Another form was described in the "Kansas Farmer" years ago:—"I had rivetted together two sheets of stove-pipe iron, each 2 by 7 feet, making a surface of 4 by 7 feet. I rolled up the back side about 18 inches high, and held it to its place by nailing to it rounded inch boards. I turned up the front a trifle, and nailed to it a narrow strip of siding to stiffen the machine under the bottom, well back, so that it would balance. I fixed a three-eighths round iron for an axle, and fastened it by driving a staple over it near the ends and into the board end pieces. The wheels should be 16 inches in diameter, made of inch boards, three thicknesses nailed together, so that the grain of the wood will cross. I push my machine with a handle made of half-inch iron, a piece 12 feet long, the ends flattened, and fastened to the end board with screws, the rod bent up and made the proper shape, so as to come about to the bottom of a man's vest when operating the "dozer." I cover the surface with tar (common), which will burn and is poison to the hopper. The machine tilts over the axle and can be made to scrape the ground or raised to pass over grain or obstructions. The "dozer" is a perfect success, gathers the hoppers almost as clean as a reaper will cut grain; none get away. One week's work and 4 gallons of pitch tar will clean the worst hoppered 160-acre farm in Minnesota. At one priming with tar yesterday my man caught in about an hour a half bushel, estimated to make ten bushels when grown."



U. S. Dept. Eut., Bul. 25. A Hopper-catcher.

The machine is used with advantage early in the summer while the hoppers are small and wingless. It is drawn across the field from side to side in swathes, gradually covering the field. If the work is done on a fine day when the hoppers jump readily, and started from the windward end of the field, the vast majority of the hoppers can be destroyed. The fields can be swept with advantage several times at intervals of a few days. Re-infestation from surrounding fields is not likely to be serious, for the hoppers are then wingless and are already in good feeding grounds.

Few people realize the loss caused by these pests, feeding as they do upon the grass throughout the season. Even though not particularly evident, they are always present in the grass fields in countless numbers. I believe that in most seasons, on grass land, the hopper-dozer would repay many times the slight expense of its use.

In certain localities grasshoppers do much damage to grain fields. There seems to be but one method of controlling them, aside from reducing their numbers in the neighboring grass lands, and that is by poisoning them with Criddle-mixture. The formula for this preparation is given below. A tub of the mixture is driven along the edges of the grain field and, by means of paddles, the substance is scattered as far into the field as it can be thrown, fifteen feet or so. The hoppers will come from all the neighborhood to feast upon it, and the most of those infesting the field will be killed. Grasshoppers seem to prefer the mixture to any vegetation, and as they eat it more readily when it is damp, the application should be made late in the afternoon if the day is hot.

This method of control has been much used throughout the Canadian and United States West, and has apparently given the best satisfaction.

Criddle-mixture.—One pound of Paris green and two pounds of salt dissolved in water are thoroughly mixed with 100 pounds of fresh horse-droppings—about five 3-gallon pails. It is most conveniently made in half-barrel lots.

The Pea Weevil (Bruchus pisorum Linn). This is a small beetle one-fifth of an inch long, brownish, with two black spots at the end of the body. It feeds within the peas, and upon emerging from them leaves the well-known round holes. The injury from this pest in large pea-growing sections has been very great. The germinating power of the seed is greatly reduced and the value diminished for any purpose.

The Bean Weevil (Bruchus obtectus): a, beetle; b, larva; c. pupa—greatly enlarged.
(Chittenen, Yearbook, 1898, U.S. Dept. of Agr.)

The eggs are laid on the pods, and the young grubs, boring through the pod, penetrate the peas and complete their life-history therein. Some mature and escape by threshing time, but most remain within the grains all winter and will be in the seed when it is sown in the springtime. The only method of control is to destroy the weevils in the peas before planting time, and preferably as soon after gathering in the fall as is possible. If all peas in a district were treated properly the weevil would soon do little damage, for it breeds only, so far as is known, in cultivated peas. The weevils may be killed easily by fumigating the peas with carbon bi-sulphide, or by treating them with coal-oil, or by holding them over in tightly closed sacks for a season.

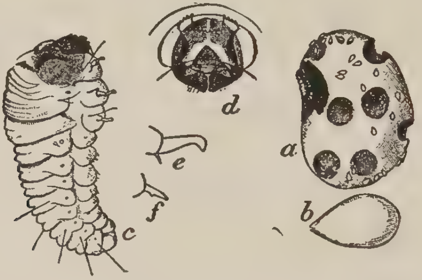
Fumigating with Carbon bi-sulphide.—Carbon bi-sulphide is a colourless, ill-smelling, inflammable fluid which evaporates rapidly when exposed to the air. It can be purchased from druggists at about 40 cents a pint. For fumigating the peas a clean coal-oil barrel is convenient. Fill the barrel with peas, about five bushels, place three or four ounces of the liquid in a shallow dish on the top and cover the barrel tightly. The fumes will sink through the peas and kill all the grubs contained without injuring the grains for any purpose. The cover must be air-tight. Fine sacking, covered with boards weighted with a stone, will answer. This should be left 48 hours. No fire of any kind should be brought near, as the fumes are very inflammable. When a large crop is to be treated a special fumigating-house is needed. The peas should be gathered on the green side and threshed and treated as soon as possible, otherwise many weevils will escape. Grubs of all stages are found in the peas at threshing time, therefore, the sooner the treatment is applied the less the injury will be.

Treating with Coal Oil.—About half a gallon of coal oil is poured over a barrel, 5 bushels, of peas and the grains thoroughly covered with it by shovelling them over and over. The shovelling should be repeated each day for several days. This treatment is applied to seed peas about two weeks before planting.

Holding over the Seed.—When peas are kept over a season in tightly closed sacks the beetles perish. They, unlike the bean weevil, will breed only in the green seeds. There is one brood a season.

The best treatment is to gather the pea crop as early as possible; to thresh at once and treat with carbon bi-sulphide; and to destroy the beetles in grains shelled in the field by deep plowing or by turning in hogs or poultry.

The Bean Weevil (Bruchus obtectus Say).—These are small beetles which resemble the Pea weevil in shape but are only half its size. They breed in both green and dried beans, and when common are extremely destructive. They were reported over a year ago near Huntingdon in Dutch beans. Descendants of specimens received at that time have been breeding in dried beans in the laboratory ever since. The eggs are laid in the field on the young pods or inserted through a slit cut between the two halves of the pod. The grubs from the eggs laid on the pod eat their way to the interior, feeding a short time on the substance of the pod, and then enter the seeds. Those from eggs laid within the pods seem to attack the seeds at once. Several grubs will be found in a seed, within which they pass their transformations. They may emerge in the fall or at any time during the winter. If the place where the beans are kept is at all warm the beetles lay eggs upon the dried beans, or cutting a slit between the seed-leaves insert their eggs. The grubs which hatch bore into and feed upon the seeds, eventually completely riddling them, even reducing them finally to shells and dried powder. I have taken twenty-four adults and young from one dried bean. The eggs laid on dried beans in the laboratory hatched in two weeks (average). The greater number were laid on the skin. The larvae wandered about on the bean for a short time, sometimes several hours, and finally entered through any abrasion in the skin or cut a round hole through any part. For a short time fine dust was extruded from the burrow. The pupae appeared in about five weeks from the hatching of the eggs, and the adults eight days later.



The 4-Spotted Bean Weevil, (Bruchus 4-maculata): Showing cowpea (a) with holes made by weevils, and also eggs on the surface; c, embryonic larva. (Chittenden, Yearbook, 1898, U.S. Dept. of Agr.)

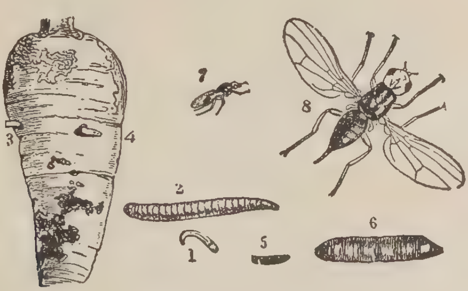
The one safe method of control is to gather the crop carefully and fumigate (as for the pea-weevil) **immediately.**

The Cabbage Worm (Pontia rapae). These soft green caterpillars of the common "white butterfly" are always plentiful on cabbages and allied crops. They breed throughout the season; many caterpillars were frozen last year on the late turnips. The parasites of this species were unusually numerous last season. A bacterial disease destroyed great numbers of the last two broods.

The standard remedy for this insect on small areas has long been white hellebore. This insecticide controls them readily enough but is rather expensive where much has to be used. On large plantations lead arsenate is now largely used; it is preferred to Paris green, on account of its greater adhering quality. Some growers use the hellebore after the heads of the cabbage are formed, others Paris green or lead arsenate for all applications. Experiments have shown that the danger from the use of these poisons is very slight. The outer leaves which carry most of the poisons are invariably removed, and the inner portion washed. It was estimated from the experiments that from 14 to 20 cabbages would be required to be eaten at once to give a fatal dose of arsenic. The only danger would apparently be from poison lodged in holes eaten deep into the heads by the caterpillars. These holes would not occur, however, if the field had been properly sprayed.

A poisoned resin wash is sometimes used on cabbages and turnips on account of its great adhering quality. Soap dissolved in the lead arsenate is an advantage in this regard. Whichever poison is used should be applied thoroughly and as often as the caterpillars become at all numerous.

The Carrot Rust Fly (Psila rosæ). This most injurious pest has been troublesome for some time in the Maritime Provinces and in Eastern Quebec, and has recently been reported about Montreal. One grower near the city lost an entire seeding of carrots last year from this cause, and we found a few infested plants, for the first time, on the College farm.

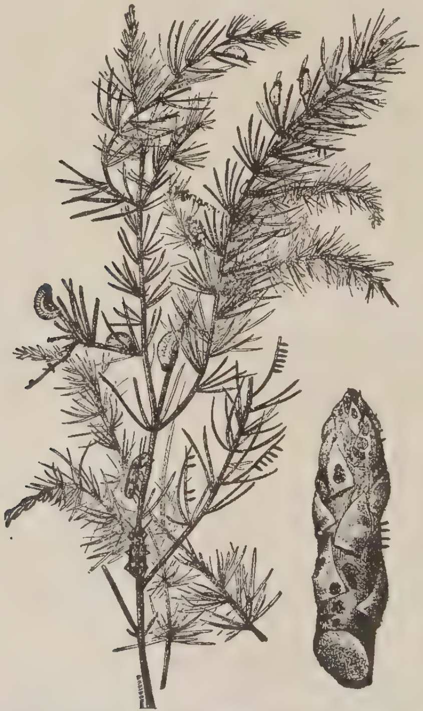


The Carrot Rust-fly—1, 5, 7, natural size; 2, 6, 8 enlarged. (Curtis).

The eggs laid at the base of a plant by a two-winged fly, hatch into maggots, which bore into the root. The young plants are often killed outright, and later the large roots, apparently but little injured, are rendered unfit for human consumption by the borings of the maggots which penetrate them in all directions.

The most effective remedy known at present is kerosene emulsion, 1 to 9, sprayed along the rows, first in June at the time of thinning, and later several times at intervals of ten days. Late sowing is an advantage. Do not sow carrots in soil infested the previous year. Bury in a pit the earth in which infested carrots are wintered.

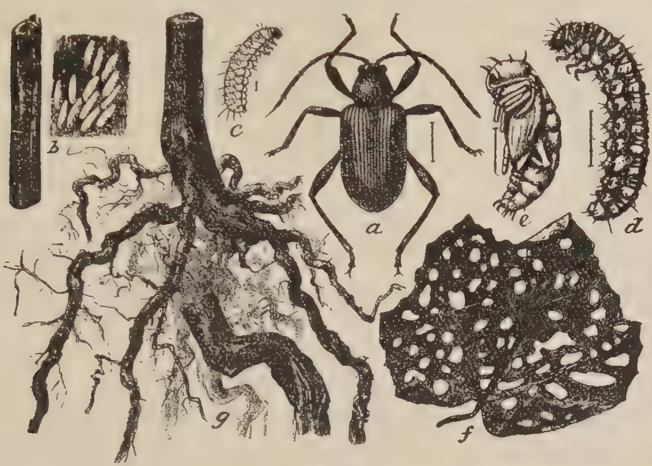
The Asparagus Beetle (Crioceris asparagi) made its first appearance on the farm in small numbers. The beetles appear early in the season from rubbish beneath which they have hibernated, and gnaw the young shoots. The longish eggs are attached endwise in rows to the shoots and hatch in from 7 to 10 days into grubs which feed upon the outer skin.



Common Asparagus Beetle on asparagus ; Showing eggs, larva and adult; asparagus top at right, showing eggs and injury. (Chittenden, Yearbook, 1896, U.S. Dept. of Agr.)

All volunteer growth of asparagus should be destroyed. The shoots should be gathered frequently so that the eggs have not time to hatch. On small patches the eggs may be rubbed from the shoots. After cropping is over the plants should be sprayed with Paris green.

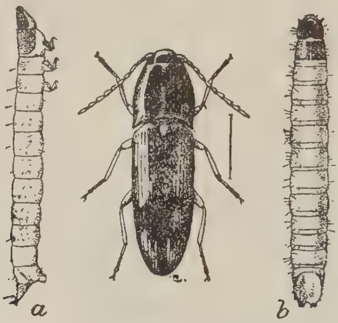
The Grape Root Worm (Fidia viticida) has been present in small numbers. It has as yet done no damage, but is well worth watching, for when firmly established it is difficult to control. The adult is a brownish beetle about one-quarter of an inch long, hoary with grayish hairs. It drops from the leaves and shams death when disturbed. During June and July they cut longish holes in the leaves, of characteristic shape. The grubs do the most serious damage in their feeding upon the roots; and when they are numerous strip away so much of the root bark with the rootlets that the vines succumb. The vines, when affected, should be sprayed with lead arsenate as soon as the beetles appear in June; a free use of a quick-acting fertilizer is of service. The grubs can be killed by using carbon-bi-sulphide about the roots, but this treatment is expensive and should rarely be necessary in this Province. Thorough cultivation in June and July apparently does much good by destroying the pupae and interfering with the feeding of the grubs.



The Grape Root-worm. a, adult beetle; b, eggs; c, d, grubs; e, pupa; f, work of beetles on leaves; g, infected roots. (Copied).

The Grapevine Flea-beetle (Graptodera chalybea) has been reported from the Eastern Townships. It has not yet been noticed on our vines. Destruction of the hibernating beetles under the bark scales, and a strong mixture of lead arsenate sprayed early, as soon as or before the first beetles appear, controls the pest. They are steel-blue beetles which appear on the grapes early in the season and feed upon the buds. Later, the larvæ feed upon the leaves.

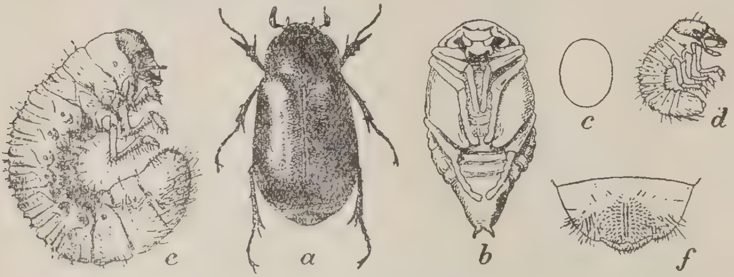
Wireworms—larvæ of the click-beetles—(Elateridæ. These are long, slender, yellow or brown, hard-skinned grubs, often found feeding on sprouting grain, and roots of other plants. The grubs live below the surface for two years and feed, under natural conditions, upon grass roots. They are always to be expected in newly broken sod land, therefore crops which they will not seriously injure, such as clover, barley or rye, should follow grass. Fall plowing does much good in destroying the pupal cells. Some farmers plow in August, harrow a week later, and cross-plow in September, with good results. Prof. Forbes, of Illinois, recommends plowing down sod in autumn, and sowing to fall wheat or rye, with clover on these in the spring, the clover to be left for two years and then followed by corn or roots.



Wireworm; Larva and adult—all three times natural size. (Chittenden, Bul. 33, Bur. of Ent., U. S. Dept. of Agr.)

Onion Thrips.—A minute yellowish insect which sometimes occurs in onion fields in great numbers, and from its feeding turns the tops white, and finally kills them. Spray thoroughly with kerosene emulsion or fish-oil soap.

White Grubs.—These are the larvae of May or June beetles. They feed normally upon the roots of grass and weeds, spending two or three years in the soil in the larval condition. When the grass is replaced by cul-

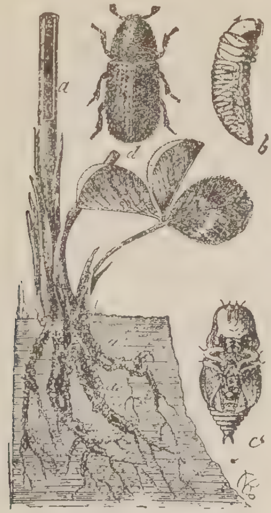


May Beetle; a. beetle; b.pupa; c. larva (White Grub)—slightly enlarged.
(Chittenden, Bull. 19. n.s., Div. of Ent., U.S. Dept. of Agr.)

tivated crops the white grubs often attack the roots of the new crop, more commonly the second season, after the grass roots are decayed. It is not uncommon to find patches of lawn or grass-land on which the sod may be rolled up like a carpet, the roots having been eaten off by these grubs. Corn, potatoes and strawberries are frequently injured by them, but clover and the small grains are seldom attacked. They are numerous here this spring in freshly broken sod-land.

Hogs turned into an infested field will root out very many of the grubs. The adults may be caught in immense numbers in trap lanterns, a lantern set on a brick in a pan of oil and water will do. If set early in the season this should have some effect in lessening the injury in following years. When the adults feed upon foliage they can be poisoned with Paris green. When white grubs injure lawns some good is done by spraying the grass thoroughly with kerosene emulsion diluted 1-9, or ordinary soap solution, 1 pound in 3 or 4 gallons of hot water. The grass should then be thoroughly sprayed with water. Sod which contains many of these grubs should be followed by clover and then one of the small grains. Later the corn or roots or strawberries would not be seriously injured. When they injure strawberry plantations the best practice is to dig them out from about the plants.

The Clover Root-borer (Hylastinus obscurus Marsh).—This serious enemy of the clover is firmly established in this neighborhood. It is very common in second year red clover plants. The adult is a brown beetle



The Clover Root-borer. (Riley).

about 2½ mm. in length. The eggs are usually laid in niches along the sides of a tunnel cut in the crown or along the root. The grubs bore through the substance of the root, often riddling it completely, and eventually causing the death of the plant. Injured plants frequently break off at the crown when pulled.

The injury is betrayed by the wilting and dying of plants over one year old, particularly during dry seasons.

The only method of control is to starve it out by plowing under the clover immediately after cutting, and this practice should be followed wherever the borer does much damage.

Blister-beetles.—Swarms of slender, soft-bodied beetles of the shape shown in the figure sometimes eat the potato leaves and prove quite injurious. Another species, M. unicolor, was common on peas, beans and vetch. Paris green or lead arsenate will destroy them; but they should not be killed unless they are actually doing injury, for in their first stages they feed upon eggs of grasshoppers.

SOME FOREST INSECTS IN THE SEASON OF 1909.

Rev. Thomas W. Fyles, D.C.L.

The prophet Joel speaks of certain insects injurious to vegetation as "God's great army." How telling a sermon might be preached upon the words! Regarding destructive insects in the light thrown upon them by Joel we may speak of such seemingly innoxious insects as, under peculiar circumstances, **might** become exceedingly injurious, as God's **army reserves.** It will be remembered that the Colorado Potato-beetle, the Larch Saw-fly, the Gipsy Moth, the Brown-tail Moth, etc., in former days received but little attention. They were, so to speak, held in reserve till time and occasion suited the full development of their destructive powers.

I wish to draw your attention to a few of the species of leaf-eating caterpillars that came under my observation last season, and that, it seems to me might under unusual circumstances, become exceedingly destructive to the plants on which they feed.

Anisota virginiensis, Drury. This moth is widely spread in the Province of Quebec. I have known it to have been taken in the Eastern Townships, at Cape Tourmente, in the Island of Orleans, at Hull, &c.

Last June a friend sent me, from Missisquoi County, some oak leaves thickly set on the under side with the eggs of the species.

The egg of **A. virginiensis** is one-twenty-fourth of an inch in diameter, globular, and of a rosy light brown; but as the larva within advances in growth it becomes depressed and loses the roseate tinge. At length the little black-headed larva snugly curled within, becomes plainly visible through the shell.

Doubtless, the eggs sent me had been deposited by several females of the kind and at slightly different intervals for they hatched irregularly. The first of the young larvae to appear left the shell on the 30th of June, and the others appeared at intervals, during the next fortnight, consequently some of them had reached the third stage while others were only in the first.

The newly hatched larva was one-eighth of an inch in length. Its head was large in proportion to its body and jet black. The mouth-organs were yellow. The body was yellow and set with short spines. The legs were pale yellow and semi-translucent.

The larvae are gregarious. They fasten themselves in their position by a fine thread, and then eat away the substance of the leaf, leaving only the mid-rib and some of the large veins. When they have finished one leaf they proceed to another on the same twig, and having stripped it, they advance to a third, and so on, moving from leaf to leaf and from twig to twig.

They moulted on the 6th of July, when they developed from the third segment a pair of seven-jointed black horns. Towards the end of the second stage they assumed a bluish green tint, with slightly darker longitudinal stripes. They moulted again on the 14th of July, and became of a sage green with yellow sub-dorsal, side, and spiracular lines. The spiracles were black, and there were several black, pointed tubercles along the middle of each segment in the upper side. At the moult on the 23rd of July they became black, and the yellow stripes and black proturberances became more pronounced. They moulted again on the 4th of August, and attained their full growth by the second week of that month. Before the end of the month, all in my keeping had buried themselves in the soil, but so late as the 13th of September I found in the woods a solitary straggler of the species.

Towards the end of their time the larvae have the strange habit after feeding of bunching themselves together at the end of the mid-rib of a skeletonized leaf. In this position they somewhat resemble the small webs that in August are so frequently seen on forest trees. They do this, probably, that they may escape the attention of birds.

Datana angusii (Grote & Robinson).—One day, in the middle of September, when walking along a lane near my home, I was struck with the appearance of a hickory-tree that spread its branches over-head. These branches were stripped bare of leaves, and the nuts upon them were very conspicuous. I looked for the cause of the defoliation, and found a number of full-grown larvae of **Datana angusii** (G. & R.) These were the laggards of a host, for they alone could not have caused such devastation. Their companions had retired into the soil.

A quarter of a mile away I found a smaller tree completely stripped, by a somewhat later brood of the same kind of larvae. They were in full possession of the tree, but they would have to migrate for their next meal, or give over eating.

Certainly the caterpillars of **Datana angusii** are a disreputable looking brood. They are of a dingy black with some indistinct, greenish yellow, longitudinal lines, and with a profusion of long sordid white hairs. They are not nearly so trim in their appearance as their congeners, the larvae of **D. ministra,** which are often seen round Montreal and in the Eastern Townships, feeding upon apple-trees. Both these species are injurious.

Symmerista albifrons (Smith & Abbott).—The late Dr. Fletcher reported the caterpillars of this species as having been "most injurious to oaks and maples" (Report 32); and Dr. A. S. Packard says of the species, "It feeds on the **oak** to which it is occasionally destructive" (Guide p.

293). I have found it upon **basswood** on several occasions. Last September I found a young tree of this kind that had been defoliated by the larvae. Many of the brood had buried themselves, but about a score of them were left; and these were finishing off a few remaining leaves on one of the topmost branches of the tree.

The larva of S. albifrons is a pretty object. It is rather long in proportion to its girth, and is marked with broad stripes of pale lilac and yellow and with finer black lines. On the eighth segment of its body there is a large orange-red hump.

These larvae drop from the tree on the slightest disturbance and lie hidden in the undergrowth.

Schizura concinna (Smith & Abbot).—Another red-humped caterpillar is that of **Schizura concinna**; but in this case the hump is on the fourth segment, not on the eighth. This larva is more robust than that of **S. albifrons.** Its body colors are white and yellow, and it is marked with wavy black lines and with black tubercles.

When I lived in Montreal in the early sixties of last century entomology had received but little attention there. Indeed, the only entomologist I could find in the city was Mr. Barnston who lived on City Councillor street. In those days I frequently found broods of **S. concinna** in the young orchards on Cote des Neiges, and, though they did much damage, the fruit-growers seemed to pay but little attention to them.

At Quebec, where apple-trees are scarce, the species feeds on the bramble. At Hull, on the 24th of last August I found a dwarf willow denuded by them. They are also said to feed on the thorn (Packard's Insects injurious to Forest and Shade Trees, p. 457).

Now, all the four species I have referred to are prolific; all are gregarious; and, in their early stages, they cluster on the under sides of the leaves of the plants which they frequent, and so escape notice. It can readily be conceived that in a succession of seasons favourable to their increase, and in a failure from any cause of the natural checks upon them, each of them might become a serious pest, especially so in the case of the two last named which feed on a variety of plants.

In the forest it would be difficult, if not impossible, to deal with them. But, in regard to those feeding upon trees grown in the open, the case would not be so difficult. Spraying by means of a nozzle that sends the poisonous fluid upward through the foliage would be a sure remedy.

In the case of young ornamental trees grown near the homestead, the use of spraying might be avoided, if, in June, the branches were lifted, and the under-side of the young foliage carefully scanned for clustered eggs and larvae, and if these were carefully destroyed.

SOME FUNGOUS DISEASES OF THE GREENHOUSE.

By W. Lochhead, Macdonald College.

1. **Carnation Rust** (Uromyces caryophyllinus (Schrank) Wint.)

Florists find much trouble in controlling the disease commonly known as Carnation Rust, although it has been known in Europe for over a century. Few records of its occurrence in Canada are to be found before 1890, and on its first appearance carnation growing was seriously threatened. It was soon found, however, that certain varieties were more resistant to the rust fungus than others; accordingly, rust-resisting varieties have largely supplanted the susceptible varieties. Moreover, the growers have discovered that the spread of the rust depends to a considerable extent on the conditions under which the plants are grown, hence greater attention than formerly has been given to matters of sanitation and cultivation.

Carnation Rust, as the name implies, is a fungus belonging to the family of Rusts, the most familiar example being **wheat rust.** Two kinds of spores are formed,—**uredospores** or summer spores and **teleutospores** or winter spores, both often growing together in small pustules on both sides of the leaf and on the stem. The pustules from under the epidermis finally ruptures, exposing the dark brown spores in elongated patches. The uredospores when observed under the microscope are nearly spherical and have thick walls which are sparsely covered with small spines. They germinate immediately in water. The teleutospores are about the same size but more elliptical and possess minute wart-like markings. They do not germinate until spring. The vegetative portion of the fungus, composed of threads, termed the **mycelium,** lives within the tissues of the plant, and continues to produce successive crops of pustules of spores during the remainder of the life of the plant. This habit of the mycelium makes it imperative that cuttings should not be taken from diseased plants. It is probable, moreover, that mature plants may be inoculated by spores of the fungus under suitable conditions and that the disease may rapidly spread through the beds.

Treatment.—While it is very difficult to prevent the development of carnation rust, experience proves that it can be controlled to such an extent that carnation culture may be carried on successfully. The means adopted are: (1) the growing of rust-resistant varieties of carnations, such as the Enchantress and Lawson; (2) attention to the watering and ventilation of the plants by placing supports of wire-mesh between the rows to prevent the leaves from falling on the wet soil, and to allow of watering without wetting the surface of the leaves; (3) the destruction of diseased plants, to prevent the spread of the disease; (4) the use of cuttings from healthy plants; and (5) the application of a fungicide at intervals of a week or ten days, the two best being a solution of copper sulphate (1 pound to 12 gallons of water), and a solution of potassium sulphide (1 ounce to 1 gallon).

2. **Damping-off of Seedlings** (Pythium debaryanum, Hesse).

Damping-off is a very common disease both in greenhouses and gardens. Many kinds of plants are subject to the attacks of this disease, of which crucifers are perhaps the most susceptible. Cucumber, sunflower, mangel, corn, clovers, millet and other grasses are also readily attacked. The vegetative portion of the fungus, the mycelium, consists of delicate much-branched threads which penetrate between the cells of the plant and destroy them. The fungus attacks the seedling at the surface of the ground and causes it to topple over. This, in its turn, will infect other seedlings with which it may come in contact, so that under suitable conditions of abundant moisture the disease spreads rapidly. Spores termed conidia are formed singly on branches of mycelium which grow out into the moist soil or air. These spores germinate immediately after their formation and attack healthy plants. Another kind of spore is formed also, but it requires a short period of rest before it breaks up into swimming spores, each capable of moving about for a time in a film of moisture. On coming to rest it germinates, sending out a tube which may enter a healthy plant.

There is a third kind of spore, an oospore, formed by the fertilization of an egg cell by a male cell, which has a thick wall and passes through a long period of rest. It also produces swimming spores before germination takes place.

Treatment.—As the conditions which favor the development and spread of damping-off are abundant moisture and warmth, it should be the aim of the plant grower to provide good drainage to avoid crowding or close planting and over watering, and to allow the entrance of plenty of sunshine and air. If these factors are attended to, there will be little danger from the attacks of this fungus.

3. **The Drop of Lettuce** (Sclerotinia Libertiana, Fckl).

This disease is frequently very destructive to lettuce crops in greenhouses, and one most difficult to control. It is also the cause of much loss in producing disease in cucumbers, rape, hemp and forced vegetables. The fungus threads, or mycelium, are parasitic on the lettuce leaves and stem, and soon cause a total collapse. As the plant decays there are formed small black bodies called Sclerotia, composed of densely packed threads of the fungus. These are very resistant bodies and may live for a considerable time under very unfavourable conditions.

Conidia or summer spores have not yet been positively identified in the life-cycle of this fungus. The disease spreads mainly by the production by the Sclerotia of a mycelium, the threads of which may inoculate healthy plants. By this means the fungus may spread rapidly from plant to plant through the soil.

There is another form of reproduction, the development of a cup form of fruiting body from large Sclerotia. Sacs containing spores are borne on the upper surface of the cup. These sac or ascopores, it has been shown, seldom inoculate the plant directly.

Treatment.—No really simple, effective method of prevention has been devised, but good sanitation in the form of good ventilation and good drainage aids materially in holding the fungus in check. Sterilization of the soil is perhaps the most effective method of stamping out the disease. "A coating of ⅝ or ¾ inch of sterilized sand or earth will materially reduce the effect of the drop, while four inches has in certain experiments completely destroyed all of the disease." Another form of partial sterilization is to treat the soil with hot water so as to raise the temperature of the surface to 176°—186° F.

Spraying with ordinary fungicides has little effect, since the Sclerotia are not destroyed.

Lettuce Drop is sometimes caused by another fungus of the same genus, **Sclerotinia Fuckeliana** De Bary, but the injury is not nearly so marked as is the case just described. The conidal stage, known as **Botrytis vulgaris**, Fr., is a very common grayish mould on fallen and decaying leaves and stems. As a parasite, however, on greenhouse plants it often does considerable injury.

As in the case of the other lettuce drop (Sclerotinia libertiana), infection occurs most frequently by means of threads sent out from Sclerotia, or from threads which are growing saprophytically on dead and decaying organic matters on the soil.

THE FLESHY FUNGI OF 1909.

Rev. Robert Campbell, D.D., Montreal.

Why the Fungi of 1909? Because so far as the fleshy Fungi are concerned, the Agaricaceae, the Hydnaceae, the Clavariaceae, the Tremellineae, the Lycoperdaceae, the Phalloideae, the Morels and Helvellas, and to a certain extent the Polyporaceae,—everything depends upon the season. Because these Fungi were greatly in evidence last year gives no assurance that there will be a good crop of them this year. The two conditions are heat and moisture,—not heat alone or moisture alone,—but heat and moisture combined. The past year furnished the necessary conditions, and so in Eastern Canada at least, there was a large production of the forementioned Fungi.

Canada is so extensive a territory, however, and conditions vary so much in different sections of the country, that what was true of Montreal and the surrounding country would not necessarily apply to other portions of the Dominion.

It is because the Fungi are parasitic plants, that they are so dependent upon atmospheric conditions. Plants that annually take root in the soil may be expected to reappear. The degree of heat and moisture affects them too, but not to the same extent. During the years 1906, 1907 and 1908, many species of Fungi were not to be found in this district because the season, when the spores might be expected to start growing, was excessively hot and dry.

In this connection there is much yet to be learned. For instance, the vitality of the spores: whether they survive one, two, three or more winters. Another fact I have discovered is that because any particular species abounded in any one spot last year, there is no ground of assurance that it will be found in the same spot next year, or indeed ever again,—the reason no doubt being that its favorite host,—decaying vegetation under ground, has ceased to afford the particular fungus nourishment.

However, it is those larger Fungi that prey upon shrubs and trees that this society is interested in specially. These belong chiefly to the great Polyporus family. Certain of the Hydnums indeed grow on trees; Hydnum Caput-ursi, and Hydnum erinaceus; but it is mainly the Polypori which are to be looked for on living or dead trees and shrubs. They are of a woody structure and are not annuals, like the softer Fungi: and so they are not so dependent as the latter upon atmospheric conditions.

Some trees and shrubs have greater powers of resistance to Fungi than others. The entire pine family, for instance, on account of the resin which is in them, are largely immune from attack by these destructive parasites. You will look in vain about a hemlock, spruce or pine stump for these Fungi that are found in masses about the decaying stumps of other trees.

Speaking of stumps, the lighter colored Fungi are to be looked for in the early stages of the decay of the stump, because feeding on the lighter fibrous matter in the outer portion of the stump; but when the wood is so much decayed that it is only in the heart any food is found for the fungus, then the dark colored species abound. Just as the sugar derived from the white outer portion of the maple is light colored, whereas when the darker wood of the heart is tapped the product is darker.

I find that the thin, smooth-barked trees are more easily affected by Fungi,—the birch most of all, which I think is to be attributed to the fact that the paper-like exfoliating layers expose the mesophlaeum; while the corky outer bark of other trees, the epiphlaeum, so long as it remains whole, seems to afford better protection. The beech next to the birch becomes as easy prey to Fungi. I have already remarked that the pine family are not liable to fungal attack in spite of their thin, smooth bark, because of their resinous properties. As a practical point I have noticed that whereever the bark is broken in a tree a fungus seems sure in time to find a home there. I roamed a good deal through the woods last season and I observed the vitality of a great many trees being quietly undermined. In several cases it was the falling of a neighboring tree which had barked a healthy one or exposed the inner substance of the tree by breaking a limb.

The hint I have to throw out is that wood rangers have their eyes open for wounded or diseased trees as they roam the forest, and take steps to protect any wounded tree by painting the affected part or otherwise. Sugar-makers, too, should see that the notch or auger hole by which they tap their maples are afterwards so treated as to ward off the attack of Fungi.

Certain trees are the favorite prey of certain fungi as the labels on the speciments I submit show. Not unfrequently, however, the same species of fungus has no choice, its appetite not being too delicate.

Dr. Campbell exhibited and described specimens of the following fleshy fungi:

Polyporus applanatus (Fr.)—A common fungus on dead trunks and stumps; hard and woody; surface marked by concentric zones of growth; under surface when fresh is white.

P. sulphureus (Fr.)—The sulphur polyporus. Entire surface sulphur yellow; edible; forms "punk" in the wood; common.

P. betulinus (Fr.)—The birch polyporus. Hoof-shaped; smooth and brown; flesh white; grows on birch.

P. igniarius (Fr.)—Black and often hoof-shaped; surface marked by zones of growth.

P. fomentarius (Fr.)—The bracket polyporus. Color smoky grey; surface strongly zoned and furrowed; common on birch, beech and maple.

Polystictus pergamenus (Fr.)—The parchment polystictus. Very common; faintly zoned; ashy grey; tubes often torn and teeth-like.

Polystictus versicolor (Fr.)—The zoned polystictus. Velvety surface marked by concentric zones of colors; often shelving; common and quite variable.

Polystictus cinnabarina (Fr.)—The cinnabar polystictus. Pliant, thick and shelving; on dead logs and branches.

THE CROWN GALL OF FRUIT TREES.

By W. Lochhead, Macdonald College.

The Crown Gall has been for many years a widespread disease of apple, peach and other members of the Rosaceae. As the name suggests, the enlargements or galls occur mainly at the crown of the root; but they may occur either above or below the surface, and on the smaller roots. At first they are small and almost translucent but their growth is rapid, and later in the season they become brown and often spongy. On account of their occurrence at the crown some investigators believe that the galls are the result of the irritation caused by injuries produced in transplanting, by rodents, or by implements of cultivation. However, the infectious nature of the disease would suggest another cause. Many experiments have been carried out to prove this point. Hedgcock performed many inoculations of roots of rosaceous trees and shrubs with macerated galls, which showed clearly that seedlings of almond, peach, raspberry and others could be inoculated in this way, although there was a wide range of degree of susceptibility, even in different varieties of the same plant. Moreover, healthy roots became diseased when infected parts of diseased plants were buried near them.

The galls appear to possess an "annual structure, beginning their growth with exfoliation in the spring and maturing more or less by the time of leaf fall. As a rule, the mature disintegrated galls do not develop secondary galls from any portion of the old wood. Young galls may, however, spring from the collar or roots near the margin of the gall previously formed, and thus the wounds and injurious effects are intensified from year to year."—(Duggar).

Toumey, who first made an investigation of Crown Gall, thought the disease was caused by a slime-fungus which he named **Dendrophagus globosus,** as he found that a slime- fungus developed frequently on the cut surfaces of galls and the appearance of the protoplasm in certain cells of the gall suggested stages in the development of the plasmodia.

Lately, however, Messrs. Erwin Smith and Townsend of the Bureau of Plant Industry, Washington, have produced good evidence of the bacterial origin of the disease. An investigation was made of the galls on the roots of Paris Daisy (Chrysanthemum frutescens) and a pathogenic bacterial organism was isolated, with which they were able to inoculate seedlings of many plants, including raspberry, peach and apple. To this organism was given the name of **Pseudomonas tumefaciens.**

Townsend isolated pathogenic bacteria from the galls of peach, hard galls of apple, hairy root of apple, hop, rose, and chestnut. He says: "The organisms obtained from the galls of these different plants are cross inoculable and are very similar, if not identical in shape, structure and habits of growth on media with the organisms from the Paris daisy gall."

Sometimes Crown Gall reveals itself by the hairy appearance of the roots, especially in seedlings. Experiments in Virginia and other southern States "proved conclusively that seedlings with hairy roots produced trees affected by crown gall, and that by selection of the seedlings and by discarding those with the hairy root appearance the trouble could be very much reduced." (Report State Ent. and Plant Pathologist, Virginia, 1908-1909, p. 57).

Treatment.—No remedial treatment of Crown Gall has been effective in controlling this disease. The method that shows the greatest promise of controlling this disease is to plant only nursery stock that is perfectly free from the disease. Experiments have proved that scions cut from diseased trees readily inoculate healthy seedlings. As the bacteria travel in the sap it is plain that care should be taken to prevent injuries to the growing trees at the surface of the ground during the cultivation of the orchards.

REPORT ON INSECTS OF MONTREAL.

Albert F. Winn, Westmount.

I have again the difficulty of submitting a report about nothing; for during the year no specimens of nor enquiries about injurious insects have reached me. The crops seem to have been excellent—perhaps the scarcity of insect life has a good deal to do with this fortunate condition, the more **bugless** years we have the better for the agriculturist and the horticulturist. The very late cold spring in 1909 checked effectually the tent caterpillars, which appeared in very considerable numbers early in May, making their well-known little triangular webs in the apple and choke-cherry trees.

There were very few Tussock Moths about Montreal, and at the present time there seem to be less of the egg-masses than almost any spring, if not any spring for twenty years. This is by no means a sign of continued exemption from this conspicuous and untidy caterpillar, rather the contrary.

During the month of August great swarms of the snow-white linden moth, Ennomos subsignarius, appeared about the street lamps in the city, making a phenomenon resembling a miniature snow-storm at nearly every street corner; on several evenings and on the following days the trees and buildings were spotted all over with the tens of thousands of pure white moths, all holding their wings folded back over their bodies as the butterflies do at rest. That these moths bred in the woods within a few miles of Montreal is possible, but that thy were migrants is much more likely. Usually the moth is of quite rare occurrence in this Province.

The fall web-worm's nests were not so numerous as in 1908, but still an eye-sore. It is to be hoped that the new administration at the city hall will take some steps towards protecting and looking after the rapidly diminishing rows of trees. Between the insects, the lack of moisture at their roots owing to cement roads and sidewalks, and the heartless manner in which great boughs are removed to allow electric wires to have the right of way, the trees of which Montreal used to be so justly proud are having a hard time of it. As in their native haunts when the original timber is cut a new growth of another sort springs up, so we in Montreal have now a fine collection of telegraph, telephone and electric light poles of various sizes, shapes and colours on which this Society might very properly introduce some destructive insect or fungous pest, if one could be discovered with such depraved tastes.

The year just passed seems to have been very favourable for the development of aphides on our garden flowers but, on the other hand, there seemed to be few cut-worms.

During the early part of July there were great numbers of the little moths of the Spruce-tortrix (T. fumiferana) throughout the city, evidently attracted by the electric lights from swarms bred somewhere at a distance where the spruce is more abundant. The insect has appeared simultaneously in enormous numbers, both in Eastern Canada and New England, and in British Columbia the last two years. and if it should continue to increase, might prove a very serious pest indeed to one of our most valuable assets, the spruce tree ; so far, it looks as if the injury were only temporary loss of the leaves and that the next season's growth would replace these.

Between Montreal and Montreal West, in July, a great many apple trees were noticed, with whole branches whose leaves were of a sickly lemon yellow colour. I was in the car at the time and was unable to make out the cause and did not have another opportunity to visit and inspect any of the trees.

The typhoid fly (Musca domestica) is still as common as ever in our midst, and in spite of the unusual prevalence of the disease, with the many lamentable fatalities, no effort whatever has been made to guard against this loathsome insect which is known to play a most important part in the spread of the disease. How long shall we keep our eyes shut to such a menace of health, happiness and life?

Mr. Winn further remarked that the horticulturists of the Province should be particularly careful about importing nursery stock from France and Europe, on account of the Browntail-Moth. During the past year several nurserymen had imported stock that was badly affected and that in almost every case egg masses of the moth were found in the straw packing as well as the shrubs and trees. This is, indeed, an unfortunate source of insect introduction, and (in the case Mr. Winn referred to) it was only as a result of prompt action on the part of the Experimental Farms to inspect all imported nursery stock, that plague has been prevented. In almost every case the inspectors discovered egg masses of the moth.

SOME NOXIOUS WEEDS OF QUEBEC.

By W. Lochhead, Macdonald College.

The spread of noxious weeds in Quebec is truly alarming. Wherever one travels in the province the abundance of weeds forces itself upon him, and the question comes naturally to his mind.—What is to become of the farms if the spread of weeds continues almost unchecked? There appears to be but one answer to this question: Either the system of farming will be changed, or the farms will be abandoned.

The system of farming that is and has been practised for many years over large areas can hardly be called one of rotation, for there are practically but two crops grown,—cereals and hay. The acreage devoted to root crops is small and to pasture. large. There is no opportunity in this system to give a weed-infested field a cleaning, and as a result, the weeds spread and gradually take possession of the best fields.

Moreover, there is little attempt in most places to look after the weeds along the roadsides and in the pastures. They are allowed to grow to maturity and produce seed. Often these seeds are capable of being carried by the wind to considerable distances, so that they are a serious menace to farmers who are trying hard to keep their fields free from weeds.

The neglect of many years in sowing clover, timothy and grains foul with noxious weed seeds, and in allowing these noxious weeds to grow up unmolested has brought about a state of affairs which is extremely difficult to cope with at the present time. The problem of weeds is the most serious one to-day in the agriculture of Quebec. However, when one sees many farms in the province comparatively free from weeds, by virtue of the practice of an intelligent system of farming, one takes hope that something can be done to overcome the evil that is impending, and that the situation is not altogether hopeless. Nevertheless, much hard and strenuous labor will be necessary to restore the majority of the farms to a clean, healthy condition, for there is no royal and easy road to the renovation of a farm foul with noxious weeds. Fig. 1.

The most noxious weeds observed in Quebec are the following: Ox-eye-daisy, Couch Grass, Mustard, Canada Thistle, Perennial Sow Thistle, Ragweed, Chicory, Wild Carrot, Butter-and-Eggs or Toad-flax, Paint Brush, and Bladder Campion. These were abundant in most parts on the south of the St. Lawrence.

1. **Ox-eye-daisy** (Chrysanthemum leucanthemum L.). Also called **White Daisy, Marguerite** and **White-weed.**

This perennial plant is by far the worst weed of the hay field. In many sections the hay is mostly daisies, with a sprinkling of timothy. The proportions to which the hay industry has grown of recent years has necessitated the setting apart of large areas of meadowlands on most farms which cannot all be brought into the rotation. Moreover, this large amount of "daisy" hay which is fed to cattle and horses produces manure filled with daisy seeds. When such manure is spread on land which is left undisturbed, daisies will make their appearance in large numbers.

The best method of dealing with hay fields infested with Ox-eye-daisy is to put into operation a special 3-year rotation, such as the following: hoed crops, cereals, clover. The clover should be cut early, so as to prevent the daisies from seeding, and then broken and cultivated during the remainder of the season in preparation for the hoed crops of the next year. Such a treatment of the land will destroy not only the old plants but also any seedlings that may spring up.

2. **Couch Grass** (Agropyron repens L.)

Also called **Scutch grass,** or **Twitch Grass,** or **Quack Grass.** —This common weed has taken possession of many fields. Its white creeping root-stocks are very persistent and soon spread through the soil, crowding out other plants.

Authorities differ with regard to the best treatment of the soil to adopt. One method is to plough rather shallow, as soon as possible after the hay is cut, then to follow with the harrow and the spring-tooth cultivator with the object of bringing as many as possible of the root-stocks to the surface, to be killed by exposure to the hot sun. It is advisable to rake the roots together and to burn them when dried out. This cultivation should be repeated again and again throughout the season; then late in the fall, rib up the land and allow to stand over winter. In the spring the land should be cultivated again and a hoed crop grown.

According to the advocates of this method disk-harrowing of couch land is not advisable, as it cuts the shallow creeping root-stocks into fragments, which are not readily drawn to the surface by the spring-tooth harrow, and which will bud and send up an increased number of plants. Deep plowing also is not recommended, as it transplants the buds to a greater depth, thus aggravating the trouble.

Another method is to plough 6 or 7 inches deep, about 15th June, and to work the surface soil thoroughly with disc and harrows, the object being to bury the couch and to prepare a good soil for rapid growth of rape or turnips to be planted in rows. The rape should receive thorough cultivation as long as it is possible to work between the rows.

Another method, based on the same principle, is to plow 6 or 7 inches deep about May 24th, then disk and harrow thoroughly, preparatory to planting with corn.

Perennial Sow-Thistle (Sonchus arvensis L.)

This weed was observed abundantly in both grain fields and pastures. It is spreading rapidly, and is likely to become one of the most difficult of weeds to control and eradicate, especially on the clay loams of the low, undrained level lands of the St. John's and St. Hyacinthe districts. It propagates itself by means of plumed seeds and underground milky rootstocks. It can be readily told from the two annual sow-thistles (S. asper and S. oleraceus) b yits larger flower-heads, the scales of which, as well as the stems, are covered with glandular hairs.

Any successful treatment of the Perennial Sow-Thistle must follow along the line of short rotations and surface cultivation during the summer, with smothering crops, such as rape, turnips or corn.

One method is to cultivate until about the 15th of June, then sow to rape in drills wide enough apart to allow of a one-horse cultivator. Cultivation should be given every week, as long as it is possible, between the rows. After the rape is cut or pastured the land should be ridged up for the winter, and next spring given the necessary cultivation for a hoed crop.

Another common method, one which is also applicable to many other noxious creeping perennials is to gang-plough shallow after harvest, then to cultivate immediately with the broad-shaved cultivator; then plough a little deeper, followed by the cultivator every ten days as long as the season lasts, then rib up for the winter; in the spring cultivate frequently until 15th June, and sow rape.

A third method is the adoption of a short rotation of clover and cereals. The clover is cut in June and the land ploughed four inches deep. Frequent and thorough cultivation is given during the remainder of the summer.

Orange Hawkweed (Hieracium aurantiacum) also called **Paint Brush.** This weed has excellent means of distribution, for its seeds are provided with a tuft of downy hairs, by means of which they can be carried considerable distances by the wind. Moreover, it sends out runners on or beneath the surface of the ground, and is able to occupy a considerable area of land in a short time.

Once a meadow becomes infested with Paint Brush it is almost impossible to eradicate the weed without breaking up the sod and introducing a short rotation of crops. It is readily killed in cultivated land by ordinary ploughing and cultivation. It is stated by Prof. Jones, of Vermont, that the broadcasting of salt at the rate of 1-2 ton to the acre will kill the Paint Brush, and do no harm to the grass.

Much can be done to prevent further spread of this weed by mowing, spudding or cutting the plants at or before blossoming time. It is very necessary that farmers give attention to this phase of the question for there has been too much carelessness in this respect in the past.

If the Paint Brush can compel the farmers to introduce a system of rotation it will have lost its terrors and have done a good service to the province.

Land that can be cultivated should be ploughed as shallow as possible, just as soon as the hay or grain crop is removed; then roll and harrow, and in about ten days disc-harrow thoroughly. If grain stubble, cultivate without plowing. Continue sufficient surface cultivation to keep down all growth until autumn. Then plough the land thoroughly, and as deep as the plant food in the soil will allow. Next year, put on a hoed crop of some sort, cultivate the hoed crop so that nothing will grow except the seeds you have planted. In the spring, before the hoed crop is planted plough shallow just before planting, work the surface thoroughly and plant as quickly as possible so as to get the planted crop growing before the weeds begin to show. Follow the hoed crop with grain and seed with clovers and grasses 20 pounds per acre. This amount may seem heavy seeding, but good results will follow. For pastures and wood lots that cannot be ploughed, it is advisable to broadcast dry salt over the patches, so as to fall on the leaves of the plant, at the rate of 1 to 1½ tons per acre. Where salt is not used constant spudding and cutting will eradicate this very bad weed.

Wild Carrot (Daucus carota L.), also called **Bird's Nest** or **Devil's Plague.**

Wild carrot may be observed along roadsides and pastures in the St. John's and St. Hilaire districts, and probably in others. It is a biennial with a deep, strong root; spreads somewhat rapidly and is sometimes troublesome to eradicate from pastures. However, by spudding the plants well below the crown of the root, and by cutting them before they have a chance to produce seed they can be controlled.

When a pasture becomes badly infested it should be ploughed and cultivated and planted to a hoed crop.

Wild parsnip which is also common can be treated in a similar manner.

Bladder Campion (Silene inflata, Sm.)

Bladder Campion is a creeping perennial which is spreading rapidly in Quebec. Its rootstocks penetrate the soil to a considerable depth, and are difficult to kill. It spreads rapidly in hay fields that are left unbroken for a series of years. Its seeds are a frequent impurity of clover and timothy seed. It is impossible to eradicate this weed unless the sod is broken, ploughed deeply and disc-harrowed or cultivated to starve out the rootstocks, and treated to a short rotation.

Ragweed (Ambrosia artemisiaefolia L.), also called **Hogweed** and **Roman Wormwood.**

This annual is present almost everywhere,—in grain fields, in pastures and hay fields, and along roadsides, and has become a noxious weed, in spite of its being an annual.

It flowers late in the summer, and seeds after the harvest has been cut. It is very necessary that the late growth should be attended to so as to prevent seeding. After-harvest cultivation with short rotations should keep Ragweed in check. Care should be given to the sowing of grain, clover, and timothy, for these often contain large numbers of the seeds of ragweed.

Common Mustard (Brassica sinapistrum, L.), also called **Herrick** or **Charlock.**

Mustard continues to spread at an alarming rate through the townships. One of the worst features of the situation is the seeming indifference to the weed. As a result, the soil is becoming charged with the seeds of mustard which will take years of careful cultivation to eradicate.

Mustard is an annual, and in its initial stages is readily controlled by preventing the formation of the seeds. When a field becomes infested the stubble land should be gang-ploughed after harvest and immediately harrowed. As soon as the seeds have had time to sprout the seedlings should be destroyed by harrowing. This cultivation should be repeated at intervals all autumn and followed by a well cultivated hoed crop the following season.

Mustard plants in grain fields can be destroyed by spraying the fields with either blue-stone or green vitriol solution. The blue-stone solution should be of 2% strength, that is, 8 or 10 pounds of blue-stone should be dissolved in 40 gallons of water. The green vitriol solution requires to be of a 20% strength, i.e., from 80 to 100 lbs. in 40 gallons of water. As blue-stone costs about 8 cents per lb. and green vitriol about ¾ of a cent per lb. there is practically no difference as to the cost of the applications. The mustard plants should be sprayed on a clear day while they are young or are just coming into bloom.

Toad-Flax (Linaria vulgaris L.) also called **Butter-and-Eggs.**

This weed is prevalent on the Island of Montreal and throughout the Eastern Townships. It is a perennial with deep rootstocks and is a difficult weed to eradicate from meadows and roadsides. The plants should be cut at intervals, to prevent seeding, and the formation of leaves.

To rid land infested with toad-flax it is necessary to plough it and to give it such cultivation as will prevent the development of leaves and the making of starch. By such means the underground root-stocks are gradually starved. A short rotation with a root crop is probably as effective a method as possible to adopt.

Chicory (Cichorium Intybus L.).

This plant is becoming very abundant in Quebec, not only in pastures but also in grain crops such as barley and oats. It has a deep perennial tap root which is difficult to eradicate, and blue flowers similar in shape to those of the dandelion. In pastures and on roadsides this weed may be kept in check by spudding the roots well below the crown. In cultivated fields that are badly infested a short rotation, such as that suggested for the ox-eye-daisy, will be required to subdue it.

SCALE INSECTS IN GREENHOUSES.

By W. Lochhead, Macdonald College.

Most persons who have ever attempted to grow the larger house plants, such as crotons, oleanders, lemons, date palms, ferns and acalyphs, which find their habitat in tropical regions, have no doubt felt frequently aggrieved on account of the presence of soft insects which do considerable harm. These soft insects are very diverse in character, some of them having a mealy appearance, while others are quite scale-like. The crotons and the oleanders are especially troubled with the mealy-bugs, while the lemons and ferns harbor a species of a soft scale called lecanium.

There are usually two species of the mealy-bugs common in greenhouses, the **destructive** and the **long-threaded.** Unlike most scale insects, they can move about the plant somewhat freely. It is only when they become mature that they secrete the cottony sack which is so characteristic of them. Within this cottony sack are deposited the cream-colored eggs, which in a short time hatch out the young mealy-bugs. Fig. 1 shows clearly the appearance of these two mealy-bugs. With regard to remedial treatment, probably the best method of dealing with these insects is to wash the plants with a soap solution, or to dip the entire plant in the solution, if such is practicable. In either case the plant should be drenched with cold water to wash off the solution. Another remedy which has been highly commended is an alcoholic extract of Persian insect powder. This is made as follows: Alcohol, ½ pint; insect powder, 2 ounces. These are allowed to stand for about a week, then filtered and diluted with an equal quantity of water. The solution is then applied with an atomizer. It will be necessary in most cases to repeat the treatment.

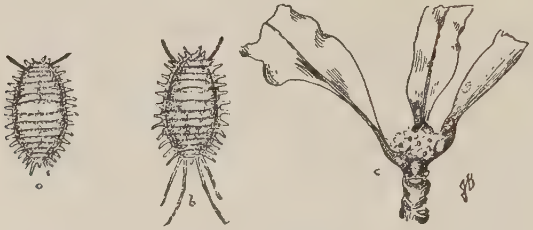


Fig. 1—Mealy-bugs. a, Destructive Mealy-bug; b, Long-threaded Mealy-bug; c, eggs in cottony sack.

Mealy-bugs require about six weeks to complete their life circle, that is, from the eggs of one generation to the eggs of the next. The soft scales or lecaniums, are frequently quite troublesome to greenhouse and indoor plants. They may be readily recognized by their oval-shaped bodies. Most of them are oviparous, that is, egg-layers. The eggs are produced in large numbers under the scale. Perhaps the most common lecanium of the greenhouse is the oleander scale (Lecanium oleae). Fig. 2 shows the form of the scale and the way the scales are arranged on oleander leaves.

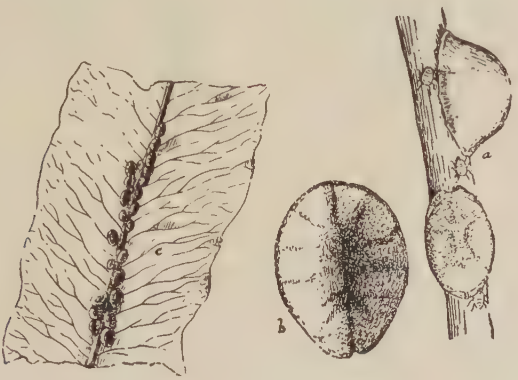


Fig. 2—A Soft Scale of Oleander. a, mature female; b, flat male scale; c, arrangement of scales along mid-rib of leaf.

Lecaniums are also frequently found on indoor ferns, on oranges, on lemon plants, and on acalyphs, which resemble the oleander scale to a great extent, but are referred to different species, such as the **hemispherical scale** and the **orange scale.**

The treatment for the soft scales is similar to that used against the mealy-bugs. Small plants are often dipped in soap or tobacco solutions. The most certain remedy is the hydrocyanic acid gas treatment, similar to the method adopted in the nurseries against the San Jose scale. A special compartment is necessary for this work, and special precautions must be taken with regard to quantities used and against possible poisoning. The writer will be pleased to give full directions to anyone who would like to try this method.

Among the armoured scales which infest greenhouse plants are the Florida red scale (Aspidiotus ficus), and Bouchè's scale (Aspidiotus hed-

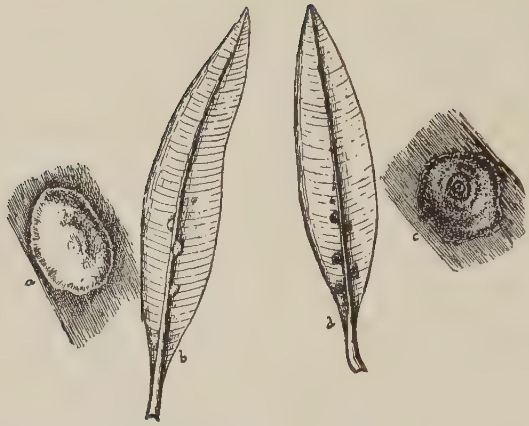


Fig. 3—a, Bouche's scale; b, Bouche's scale on a leaf; c, Florida red scale; d, Florida red scale on a leaf.

erae, or nerii). Fig. 3 shows the form of the scales. The former scale is nearly circular in outline, about 1-25 inch in diameter, and dark brown in colour. The latter is not so circular, and is white. It is found on a large number of greenhouse plants, such as oleanders, cycas, yucca, acacia, etc.

With these scales the treatment with soap or tobacco solutions is to be commended. Repetition is necessary, and when the plants are dipped they should be rinsed afterwards with clear water.

There are many other scales which are usually found in every large greenhouse containing tropical plants, but enough has probably been said to draw the attention of the owners to the commoner scales and to the best methods of treatment.

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THIRD ANNUAL REPORT

OF THE

Quebec Society for the Protection of Plants from Insects and Fungous Diseases

◆

1910-1911

◆

PRINTED BY ORDER OF THE LEGISLATURE

QUEBEC
LOUIS V. FILTEAU, KING'S PRINTER
1911

THIRD ANNUAL REPORT

# of the

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

from

INSECTS AND FUNGOUS DISEASES

1910-1911.

To the Honourable J. E. Caron, M.P.P.,
Minister of Agriculture,
Quebec.

Sir :—

I have the honour to present herewith the Third Annual Report of the Quebec Society for the Protection of Plants from Insects and Fungous Diseases, containing the proceedings of the Summer and Winter meetings of the Society, which were held at the Agricultural Institute at La Trappe, and at Macdonald College, Ste. Anne de Bellevue, Que., on the 28th and 29th of September, 1910, and the 23rd of March, 1911, respectively.

Included are the papers that were read, and the reports of the officers of the Society.

I have the honour to be,
Sir,
Your obedient servant,
J. M. SWAINE,
Secretary-Treasurer.

Macdonald College,
Que., 1911.

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

OFFICERS FOR 1910-1911

President—William Lochhead, B. A., M. Sc., Professor of Biology, Macdonald College, Que.

Vice-President—Mr. Auguste Dupuis, Director of Experimental Fruit Stations, Village des Aulnaies, Que.

Secretary-Treasurer—J. M. Swaine, M.Sc.A., Lecturer in Entomology and Zoology, Macdonald College, Que.

Curator and Librarian—J. M. Swaine, M.Sc.A., Lecturer in Zoology and Entomology, Macdonald College, Que.

Directors—Rev. Dr. Thos. Fyles, Hull, Que.; Rev. Brother Liguori, La Trappe, Que.; Rev. Geo. Ducharme, Rigaud, Que.; A. F. Winn, Esq., Montreal, Que.; Prof. L. S. Klinck, Macdonald College, Que.

Auditors—Rev. Father Leopold, La Trappe, Que.; Prof. John Brittain, Macdonald College, Que.

FINANCIAL STATEMENT
of the
QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS FROM INSECTS AND FUNGOUS DISEASES
1911

RECEIPTS.

Brought forward	$321.08
Interest on deposit to June 30th, 1910	4.88
Interest on deposit to December 31st, 1910	4.36
	$330.32

DISBURSEMENTS.

Members' Expenses to Winter Meeting	$ 9.20
Members' Expenses to Summer Meeting	16.50
Expenses of Delegates to Annual Meeting of the Ont. Ent. Soc.	25.70
Expenses of editing Annual Report	10.00
Stamps	2.00
	$ 63.40
Balance, cash on hand, March 23rd	266.92
	$330.32

DOUGLAS WEIR,
Sec.-Treas. (for 1909–10).

WILLIAM LOCHHEAD,
President.

Auditors :
J. M. SWAINE,
A. F. WINN

NOTE.—The cost of publishing the Report for 1909–1910, the salary of the Secretary-Treasurer for 1909–1910, and assistance towards the formation of a list of Quebec Insects stand against the balance shown above.

J. M. SWAINE,
Secretary-Treasurer.

MEMBERS OF THE QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

Arkell, H. S.	Dept. Agr., Ottawa.
Brittain, Dr. John	Macdonald College.
Blair, Prof. Saxby	“ “
Bates, F. W.	“ “
Barton, H.	“ “
Brittain, Wm.	“ “
Browne, F. S.	Macdonald College.
Buck, F. E,	Macdonald College.
Campbell, Rev. Dr. Robt.	Montreal.
Chagnon, G.	“
Chapais, J. C.	St. Denis-en-bas, Que.
Cooley, R. B.	Macdonald College.
Cutler, G. H.	“ “
Davis, M. B.	Yarmouth, N.S.
Dimitriou, G.	La Trappe, Que.
Dreher, W. C.	Macdonald College.
Ducharme, Rev. Geo.	Rigaud, Que.
Dupuis, Auguste	Village des Aulnaies, Que.
Durost, H. B.	Macdonald College.
Delaire, O. E.	St. Hyacinthe, Que.
Dasen, H.	Macdonald College.
Edouard, Rev. Brother	La Trappe.
Elford, Fred. C.	Macdonald College.
Elwell, R. W. D.	“ “
Flewelling, D. B.	“ “
Fyles, Rev. Dr. Thos. W.	Hull, Que.
Grignon, Dr. W.	St. Adele, Que.
Grisdale, F.	Macdonald College.
Hall, Landon	Cowansville, Que.
Hammond, H. S.	Macdonald College.
Harrison, Dr. F. C.	“ “
Huard, Rev. Abbe	Laval University, Quebec City.
Jack, Norman E.	Chateauguay Basin, Que.
Klinck, Prof. L. S.	Macdonald College.
Leopold, Rev. Father	La Trappe, Que.
Liguori, Rev. Brother	“ “
Lyman, Henry H.	Montreal.
Lochhead, Prof. Wm.	Macdonald College.
MacClement, Dr. W. T.	Queen's University, Kingston, Ont.
MacFarlane, J. R. N.	Macdonald College.
Moore, G. A.	Montreal.
Nantel, G. A.	Montreal.
Nagant, H.	Quebec City.
Newman, C. P.	Lachine Locks, Que.
Parent, L. V.	Grande Ligne, Que.
Reid, Peter	Chateauguay Basin, Que.
Reid, T.	Macdonald College.
Robinson, J. M.	Macdonald College.
Savage, A.	Montreal.
Spencer, C. M.	Macdonald College.
Straight, E. M.	Macdonald College.
Swaine, J. M.	“ “
Summerby, R.	Beech Ridge, Que.
Sweet, C.	North Sutton, Que.
Tourchot, A. L.	St. Hyacinthe, Que.
Vanderleck, J.	Macdonald College.
Victorin, Rev. Brother	Longueuil, Que.
Winn, A. F.	Montreal.
Williams, C	Macdonald College.
Wood, G. W.	Genoa, Que.
Weir, Douglas	Macdonald College.

Honorary Member :

James W. Robertson, Esq., LL.D., C.M.G.

THIRD ANNUAL REPORT

# of the

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

Report of the Second Summer Outing

The Second Summer Meeting of the Quebec Society for the Protection of Plants was held at the Agricultural Institute, La Trappe, Que., on September 28th and 29th, 1910.

In addition to the members resident at La Trappe, there were present : Professor Lochhead, Professor Blair, Mr. Weir, Mr. Swaine, Mr. Williams and Mr. Gorham, all of Macdonald College.

The visitors were welcomed by the Rev. Father Abbot Antoine, the Rev. Father Edouard, the Rev. Father Leopold, the Rev. Brother Liguori and Professor Marsan.

After lunch excursions were organized for the study and collection of weeds, fungous diseases and injurious insects. Many of the students of the College joined in the excursions, and the entire afternoon was devoted to this work.

In the evening a meeting was held in one of the lecture-rooms of the Institute, and the collections of the afternoon thoroughly discussed.

Professor Lochhead spoke on the fungous diseases collected, describing the nature of growth, and the methods of control of such fungi as the oat smut, wheat rust, late potato blight, potato scab, grape mildew and apple mildew.

Mr. Swaine dealt similarly with the insects collected, but limited his remarks more particularly to the discussion of the codling-worm, the apple aphis and the plum curculio.

Mr. Weir spoke on the farm weeds, emphasizing the importance of knowing the common weeds and their seeds which occur so commonly in clover, timothy and grain.

The Rev. Brother Liguori gave a resumé in French of the English addresses.

The Rev. Father Abbot brought the meeting to a close after a few well chosen remarks on the importance of the subjects discussed by the speakers of the evening.

The following morning the excursions were continued, and a final session was held at one o'clock, at which addresses were given by Professor Lochhead, Father Edouard, and Father Leopold. After a general discussion, in which many of the students of the Institute took part, the meeting was adjourned.

Report of the Winter Meeting

The Third Annual Winter Meeting of the Quebec Society for the Protection of Plants was held at Macdonald College, on March 23rd, 1911.

The opening business meeting was called to order at 2 p.m., by the President, Professor Lochhead, of Macdonald College. There were present :—

Professor Lochhead, Macdonald College.
Mr. J. C. Chapais, St. Denis, Que.
Mr. A. F. Winn, Montreal, Que.
Professor W. S. Blair, Macdonald College.
Professor L. S. Klinck, Macdonald College.
Professor J. Brittain, Macdonald College.
Mr. Douglas Weir, Macdonald College.
Mr. J. M. Swaine, Macdonald College.
Mr. G. H. Cutler, Macdonald College.
Mr. W. H. Brittain, Macdonald College.

The minutes of the last meeting were read and approved. The report of the Treasurer was then read, and, after being audited by Messrs. Winn and Swaine, was found accurate and approved.

The following motions were passed in regular order :—

That the sum of $50.00, voted last year for assisting in the compilation of a catalogue of the injurious insects of Quebec be made available for the coming year.

That a like amount be available for assistance towards the compilation of a list of the injurious fungi of Quebec.

That $50.00 be allowed members for railway expenses in connection with this important work.

That the Secretary-Treasurer receive an annual stipend of $50.00, and that $75.00 be awarded the Secretary, Mr. Weir, for past services.

It was resolved that the next Summer Meeting should be held at La Trappe, Que.

It was further resolved that provision be made to send a representative from the Society to the winter meetings of the Ontario Entomological Society.

The resignation of the Secretary-Treasurer was then presented. As Mr. Weir was leaving the College and would be unable longer to perform the duties of Secretary, his resignation was accepted.

After a few remarks by the President in appreciation of Mr. Weir's valuable services to the Society, a vote of thanks to Mr. Weir was passed by the meeting.

The following officers were elected for the ensuing year :—

President—Professor W. Lochhead, Macdonald College, Que.
Vice-President—Auguste Dupuis, Village des Aulnaies, Que.
Secretary-Treasurer and Curator of the Museum—J. M. Swaine, Macdonald College, Que.

Board of Directors :—Rev. Brother Liguori, La Trappe, Que.; Dr. Thos. Fyles, Ottawa ; G. Ducharme, Rigaud, Que.; A. F. Winn, Montreal ; Professor L. S. Klinck, Macdonald College.

Auditors :—Rev. Father Leopold, La Trappe, Que., and Professor Brittain, Macdonald College, Que.

The business meeting then adjourned.

The general meeting was called to order in the lecture-room of the Biology Building, at 3 p.m., by the president, Professor Lochhead. In addition to members of the Society many students were present. Mr. Güssow, Dominion Botanist, of Ottawa, took an active part in the discussion of the papers. The papers read and discussed are included in the body of the Report.

The evening lecture of the Society was delivered by Mr. Güssow, of Ottawa. It is included below in this Report. Mr. Güssow's lecture, illustrated by lantern views, was entertaining and instructive, and was very much appreciated by the large audience. At the close of the address, the President expressed the appreciation of the meeting and of the Society, and our pleasure in thus formally making his acquaintance.

THE PRESIDENT'S ADDRESS.

Gentlemen :—

It is my pleasant duty to welcome you to our Third Annual Meeting. Our programme for this meeting is a full one, and the papers to be read will, I hope, be fully discussed.

The summer meeting held at the Oka Agricultural Institute, La Trappe, Sept. 27th–28th, was a most successful and educative one. Portions of two days were spent among the woods, orchards and gardens of the monastery, collecting and studying the insects and plants, and two meetings were held with the students at which the collections were discussed.

Personally I enjoyed every hour of the time we spent at La Trappe. I would suggest that our next summer meeting be spent either at La Trappe or at Ste. Anne de la Pocatière. It is worth a great deal to meet with the young men and to interest them in the work which our Society was organized to carry out.

The late appearance of our Second Annual Report was due to the disastrous fire last June at the Herald Building, Montreal, when most of the copy was either destroyed or lost for a time. It is hoped that our Third Report will be published promptly this year.

The time has come when we must do more aggressive work. We must find time during the summer season to visit various parts of the Province and to study the weeds, the insects, and the plant diseases that are doing injury. I believe we could not put our Government grant to better use. We would in this way get acquainted with the fruit-growers, the market gardeners and the farmers, and could advise them as to the best methods of combating the pests.

The formation of four co-operative fruit-growing societies in different parts of the province offers an excellent opportunity for making an intensive study of the pests at those places, and this Society should make a point of keeping in direct touch through some of its members with these co-operative societies.

Last year our Society placed the sum of fifty dollars at the disposal of those of its members who were willing to undertake the preparation of a catalogue of the insects of Quebec. A beginning has been made by Messrs. Winn, Chagnon and Swaine, but as it takes considerable time to make headway, these members beg leave to report progress with leave to continue their work for another year.

I would also call the attention of the Society to the urgent need for a catalogue of the Fungi of this Province, and the making of this catalogue would also seem a fit and proper piece of work for this Society to undertake. There is probably on the part of the public greater ignorance regarding fungi than insects, and it will require a large amount of personal collection and identification before a trustworthy complete catalogue can be prepared. Funds should be set aside to aid any of our members who may be willing to begin work on such a catalogue.

A Need for Sets of Prepared Specimens for Distribution.

There is another feature of our work as a Society for the Protection of Plants from Insects and Fungous Pests that may well deserve some consideration. Our reports, I am pleased to state, are filling a long felt want by serving as authoritative bulletins on the economic insects, fungi and weeds. They are being freely used in some places as text-books for the use of students of agriculture and horticulture, thereby serving a most valuable and important place in the absence of suitable books on Economic Entomology and Plant Pathology. We must continue to make our reports compendia of information for the student as well as the fruit-grower and general farmer.

But there is a pressing need for something else. There is a great need for sets of the actual examples of the economic forms discussed and illustrated in our reports. Experience tells us that illustrations and descriptions are not sufficient in themselves to enable the ordinary man to recognize the forms so treated ; actual specimens should be at hand so that the student or fruit-grower may be able to identify the same forms when he comes across them in the field.

These sets of prepared and named specimens could be distributed to the Agricultural Schools, Normal Schools and some of the Fruit-Growing Societies. By doing this work our Society would, I am sure, extend its usefulness and accomplish to some extent the end for which it was founded.

This, however, is no easy task, but if the Department of Agriculture would help us by providing suitable cases for the specimens and by paying the expenses of collecting the material required, I am of the opinion that we should undertake the work.

Losses from Insects and Fungi

At a recent session at Macdonald College of the Royal Commission on Industrial Training and Technical Education the Chairman inquired as to the extent of the losses in Canada every year from plant diseases and insect pests, and the percentage of preventable losses. Several U. S. prominent entomologists have made estimates of the annual losses from insect attacks, and curiously enough each computed the loss at about one-tenth of the total agricultural product—one half of this loss being upon the staple crops, and the other half upon truck crops, fruits, domestic animals and timber.

This loss due to insects alone in the U. S. amounts every year to the enormous sum of over 300 millions of dollars. For Canada it is believed that the loss is proportionately as large, which would make about 40 or 50 millions annually.

This is an enormous tax levied upon our agricultural products. It is hardly likely that the farmer will ever be in a position to stop fighting injurious insects on account of their scarcity. But " rational methods of general farm practice with the proper use of apparatus and insecticides, even as are now known, and in which improvements are being constantly made, if intelligently used by farmers would save to them fully two-thirds of this enormous loss."

With regard to losses from diseases induced by fungi it is more difficult to get accurate data, but there seems to be little doubt that the losses are as large as those caused by insects. When one considers the losses caused by rusts, smuts, etc., on cereal crops ; those caused by scab and blight on potatoes ; by scab, blights, etc., on orchard fruits ; and by mildews, leaf spots, etc., on garden and greenhouse plants, it will be readily seen how enormous are the losses every year.

Such losses too are to a large extent preventable. In the last fifteen years Bordeaux Mixture has been the means of preventing enormous losses on such crops as may be sprayed. Lately the lime-sulphur solution has done double duty as insecticide and fungicide in orchards. Treatment of seed for the prevention of smuts, and potato scab with formaldehyde solution is now commonly practised. The treatment of rusts of grain crops, however, remain an unsolved problem, but even here " rational methods of farm practice " including selection of seed, drainage of the soil, and rotation of crops, are producing a beneficial effect in lessening the losses due to this disease.

Many Non-injurious Insects and Fungi

As this Society was organized specially for the protection of plants from insects and fungi it must not be inferred that all insects and fungi are injurious to man and hostile to his interests. There are in fact more insects and fungi that are either beneficial or harmless to plants than there are injurious forms. To emphasize this phase of the question lest it be entirely overlooked I desire to bring to your attention a few examples of the beneficial work of insects and fungi.

The fact that most plants with colored flowers are largely dependent upon the visits of insects for their fertilization and the setting of their fruit should make it quite evident to everybody that insects play a most important part in the economy of nature, and are no mean things after all. Let us reflect for a moment on the loss to the world if the blossoms of apple, plum, peach, grape, strawberry, raspberry, among fruits were not fertilized by bees and wasps ; if the clovers were not visited by bees, and if the hundreds of the beautiful wild flowers of the fields and meadows were allowed to die without setting seeds. We are apt to forget that hundreds of different kinds of insects are doing valuable service in this regard.

In addition, we should not forget the part played by scavenger and carrion insects that feed upon dead or decaying organic matter. They help to make our surroundings purer and cleaner. Besides, " insects constitute the most important portion of the food of adult fresh water fishes, furnishing 40 per cent of their food," according to Dr. Forbes of Illinois. They also furnish food for most of our birds, although this food may consist of many noxious forms.

There are also many insects that are decidedly beneficial inasmuch as they prey upon injurious forms, or are parasitic upon them. At the present time a great experiment is being conducted in Massachusetts for the suppression of the Gipsy moth by the importation of certain parasitic insects from Europe and Japan. From an economic point of view it is important for us to know the beneficial forms so that we may not unwittingly destroy them. Few of us, I think, fully recognize the valuable work done by the modest lady-bird beetles in keeping plant lice within bounds. Without the intervention of the lady-bird beetles it is quite probable that most plants would die from the attacks of the fast reproducing plant lice. Ground beetles are also important agents in the destruction of injurious larvae, and their value can hardly be estimated.

Among fungi there are also many forms that are either beneficial or harmless. There are those that attack insects and kill them. It is not an uncommon thing to find wire worms and white grubs that have been killed by certain fungi. The extent of these attacks among insects is not well known but they would appear to be wide-spread.

There is an immense group of fungi that feed upon dead or decaying organic matter. They are saprophytic ; they are scavengers; they prepare the way for the entrance of saprophytic bacteria, Almost every dead leaf twig or branch one picks up is permeated with the threads of some of those fungi, and the woody tissues are being fast destroyed. As the successive stages of decay are reached new forms of fungi stand ready to enter, and begin feeding on the decomposing tissues. In time the bulky vegetative forms are reduced to almost nothing and come to constitute the humus of the soil. Picture the surface of the earth with its accumulated undecayed vegetable matter of millions of years. Man could not live upon it.

In conclusion, let me remind you as members of this Society that we have a great work to perform in this province. The harvest is great but the laborers are few. Our active membership will always be relatively small on account of the fact that but few persons have the special training and the liking for the study of insects and fungi. We must not become disheartened by the paucity of our membership for the best work is frequently done by small societies. We are fortunate in having the co-operation of the staff of the Divisions of Botany and Entomology at the Central Experimental Farm, Ottawa. These gentlemen can help us much by their counsel and scientific assistance, and it may be that we can often help them in return.

EDIBLE, POISONOUS AND OTHER FUNGI

By H. T. Güssow, Dominion Botanist, Ottawa.

(On account of want of space portions of Mr. Güssow's address had to be omitted).

All fungi belong to the group of plants known as Cryptogams, or flowerless plants. They form together with the Algae the large division of Thallophytes. They are readily distinguished from the Algae by having no green colouring matter or chlorophyl. As is well known all chlorophyl bearing plants, of which the Algae are the lowest forms, build up their organic substances by means of these chlorophyl grains from the carbonic acid gas of the air (and water) and by the action of light. Owing to this total absence of green-colouring matter in fungi, we must naturally look for a very different mode of nutrition. Fungi cannot prepare their own food; they live on the organic substances provided by other green-coloured plants. This peculiarity indicates that they must live upon living or dead organisms, which are capable of supplying them with the necessities for their own life. And this mode of life of fungi is the secret of their immense usefulness. While there are a number of parasitic fungi which cause diseases in plants and animals, they are in the great minority as compared with the large number of fungi which, as I will explain, are responsible for the maintenance of vegetation and the continuation of life generally.

The great object of fungi, microscopic or of larger size, in nature, is the destruction of useless rubbish of any kind, and by their action not only to rid the world of all offensive matter, but to render it useful by changing it into essential food for other plants. Decomposition and decay is repulsive to most of us, but the disposal of any useless, and very often grossly offensive matter, is indeed our life. Without fungi the presence of all undisposed of filth and offal of organic nature would soon become unbearable. It would foul the air we breathe, the water we drink and the food we eat. All this, nature's scavenging, is the work of the millions of fungi. Consider the large amount of carbon and nitrogenous matter which is present in all organic remains, and which would be held in idle captivity, were it not rendered useful to other plants by the action of fungi. We may aim at the conservation of natural resources, but it would only concern avoidable waste of what nature provides for our use. These small organisms are truly conservers of life—though it may seem contrary that such are the results : Life maintained by the destruction of life, brought about principally by putrefaction, decay and decomposition. Pure air, pure water, health of man and beast are all direct consequences of the work of Fungi.

According to their more simple or complicated structure, we may classify Fungi into seven main groups:

1, Bacteria; 2, Yeast-fungi; 3, Moulds; 4, Rust-fungi; 5, Smut-fungi; 6, Ascofungi; 7, Basidiofungi.

The first group of fungi which we are to review are bacteria. These are probably the most minute organisms known. Their bodies consist of a simple cell of globular, oval or cylindrical, of a straight, curved or wavy shape. They may occur singly, in groups of from two to four, in clusters or in more or less long chains. The body of the smallest individual measures much less than 1|25000 of an inch. Bacteria occur in the air, water, soil. They are naturally present in milk, cream and other beverages, like beer, wine, etc. They give a peculiar taste to mineral waters. They flavour our butter and cheese. Samples of butter and cheese which have been made experimentally under perfectly sterile conditions are tasteless and rather indigestible. Bacteria play a very important role in the decomposition of all vegetable and animal matter, acting with extraordinary rapidity. They are present in the soil in large numbers and in this situation are largely concerned in the fertility of soils, either by their direct action on organic remains or by their fixation of nitrogen. It has long been known that no plant growth can take place in sterile soils. You are equally familiar with the purpose of the root nodules occurring on all leguminous plants. These are by far our most important conservers of nitrogen, so important a food for all kind of vegetation.

Our next group of fungi are the **Yeast Fungi.** Yeast fungi are globular or oval cells, occurring singly or in branched chains. They are in appearance similar to some Algae, but of course possess no chlorophyl. Their reproduction takes place by a process of building. New cells are produced from the parent cell; this process of production is surprisingly rapid. The rapidity with which they increase in number and particularly their peculiarity of acting upon sugar and sugar-containing solutions, has caused them to be largely employed in the fermentation industries. Fermentation is the process of changing sugar into Carbonic acid gas and alcohol. The most important use of yeast is made in baking, brewing, distilling. In each different branch of this industry particular kinds of yeast are employed.

The next group for consideration is the **Mould Fungi.** Structurally they are very distinct from both the former groups. We meet here with three distinct parts in these organisms. First, we have a root-like system known in fungi as mycelium, which really serves the fungus plant for similar purposes as roots do higher plants. Secondly, we have a system of fine stalks or stems, and finally, their fruiting bodies or spores. Spores of fungi consist mainly of a simple cell protected by a more or less thick cell-wall. The germination of spores may give rise to a new plant of its kind. While a spore formation is not unknown in bacteria and yeast, yet their functions are different to those of this and the following groups of fungi. Mould fungi are the most useful scavengers of nature. Among the moulds there are a few which have been made use of. The flavour of some kinds of cheese is enriched by the use of moulds. The greenish portions found in Stilton and Gorgonzola are common moulds, without the presence of which these cheeses would not possess the peculiar flavour liked by many people. Some species of mould are very useful in the control of insect pests. Fungi by their parasitic mode of life, frequently destroy other life, but we can only regard such destruction as very useful, if it rids us of troublesome and dangerous insects like house flies, grass-hoppers, caterpillars, etc. The most common mould of this kind may have been observed by many of my hearers. It is not uncommon to find during the late autumn months, flies, sitting life-like but motionless on window panes, wall-papers or other substrata. On closer examination we find that life is extinct and that the flies firmly adhere to the substratum on which they may be observed. The body is surrounded for about an inch or less with a white powdery mass, which may also be noticed breaking through the abdominal rings of the fly. This is the typical appearance of flies killed by the fungus **Empusa Muscae.** Other species of the same genus cause the destruction of caterpillars, grasshoppers, locusts and other insects.

The next two groups, that is, **Rust and Smut Fungi,** these being our most serious enemies of grain culture, may be for our purpose only referred to briefly. In Rust fungi we make the acquaintance of a peculiar mode of life. Some of these fungi change during some stage of their life the host plant from which they originally obtained their food, and continue their life history on other plants. The grain rust, for instance, appears first on grain and after the production of a first series of spores they continue their life upon the common barberry. The Smut fungi also produce characteristic diseases in grain, causing the seeds to be transformed into hard balls containing nothing but fungous spores, or no seeds will be produced and the ears will appear sooty from the large number of black spores of the fungus.

We now come to our next group, namely **Asco Fungi.** The prefix is taken from the Latin word **Ascus,** a sac; technically this very large and important group is referred to as Ascomycetes. In the former groups of fungi the spores are produced on the tips of the stalks or stems arising from the mycelium. Here the spores are produced in special conceptacles or fruiting capsules. These capsules are firm bodies of smaller or larger size which are fitted with a varying number of asci or sacs in which the spores of these fungi are produced. The ascus is a club-shaped swollen cell produced in layers or in the special conceptacles referred to. Each Ascus contains a distinct number of spores, generally eight, but each may contain only one, or 4, 6, 32 or more. On ripening the ascus takes up large quantities of water, hence a forceful pressure is exerted from within upon the cell-wall till the latter is no longer capable of expansion and bursts at the apex—is immediately contracted and the contents are shot out vehemently. The many different shaped forms, their structure, etc , form interesting objects for the microscopist. The microscopic forms of this group of fungi are, like all the others, useful scavengers. But this group is the first which contains specimens of considerable size, which provide delicious food for our tables. Fungi have been eaten for many centuries. Uncivilized nations have come to adopt some varieties for food to a greater or less extent. It may be said that in the older countries, like England, France and Germany, fungi of all kinds are eaten and form an important change in diet. The consumption of fungi as food has one serious drawback. Many sad fatalities occur daily during the mushroom season in all countries from eating poisonous specimens. To us it is, therefore, of the greatest importance to know how to avoid such serious mistakes. Species may vary considerably among themselves. Different genera may appear to the beginner alike and for this reason great precautions become necessary and it is always best not to touch a mushroom of which one is not absolutely sure. Edible and poisonous fungi are a very meaningless distinction—there is no sign, no method known by which their true nature may be recognized, unless by chemical analysis. I have heard it said by some people, that all toadstools are poisonous which have pores and not gills. Those who believe this I would invite to taste some of our most delicious fungi, **Boletus edulis** and many others of the same group. Frequently the theory is advanced that when a fungus after cutting it in halves turns blue on exposure to air, this is a true sign of its being poisonous. This is quite erroneous, although the bluish colour is noticeable in some Agarics, it is entirely due to oxidation by the air of the fat substances contained in fungi. In some fungi there is no danger from eating them in a fresh and perfectly sound condition, the same fungus may turn to be very seriously poisonous, when very slightly decayed. In others, the poisonous principles disappear after boiling, or drying; there are, however, some of our most poisonous fungi which may be boiled for hours, the water changed several times and yet they are just as poisonous as when fresh. So I am sure we all will realize that it is far better not to eat mushrooms or toadstools at all, unless one is quite familiar with them. I confess that I am frequently very anxious about the possible injuries that may result from the eating of fungi which I myself have declared to be edible. This I must explain somewhat. Frequently I receive at the Experimental Farm fungi from all over Canada for identification, especially for my opinion as to their edibility. These fungi frequently are sent by people who have no idea of any differentiation, and though I may determine the fungi sent as edible, I have no assurance that those collected by the sender in good faith the next time are the same he really submitted to me first. We have, however, a series of edible fungi, which by their characteristics cannot possibly be confused with others, and those who are interested can soon familiarize themselves with these, as easily as it is, for instance, to know wild birds or wild plants.

Many fungi are delicacies, like oysters, caviare, etc. To return to the group of fungi which we had under consideration last. The Morels for instance occurring in Canada are all edible. They are so easily recognized, their appearance readily remembered, that they may be collected and eaten whereever found. They are from 2 to 8 inches in height. The ochre or darker brown cap is remarkably pitted and of conical shape. The Morels may be found from May to the beginning of July in damp localities. Their taste is very agreeable, they may be eaten when fresh, but it is advisable to boil them first in water and throw this away. They must also be washed very carefully or the sand which they very generally contain makes itself unpleasantly felt when eating them. In countries where Morels occur in large masses, they are dried in the air, kept in dry places. They may be used at any time having retained their full flavour.

There is now only left for consideration the last group of **Basidio-Fungi.** The Basidiomycetes are so called because of their spores being produced on special cells or basidia, which are more or less club-shaped and terminate generally in four small stalks, each of which bears one spore. These basidia or spore carriers are present throughout this very large group of fungi. They occur in special layers which are known as the fruiting layer. The fruiting layer may be produced in various ways, and according to this variation this group is subdivided into five other groups: 1, Puffballs; 2, The Coral fungi; 3, Hedgehog fungi; 4, Tube bearing fungi; and 5, Gill bearing fungi.

Puffballs, no doubt, are familiar objects to all naturalists. In these fungi the fruiting layer is contained in the interior and the spores are dispersed through a hole at the apex. One of the most important edible species of this group is the well known Giant Puffball (**Lycoperdon giganteum**), which may grow from the size of a fist to that of a cabbage head. This species is found late in the season in grassy or sandy situations. All puffballs occurring in Canada are edible, but they should not be used unless they are perfectly white throughout the interior. The Coral fungi or Clavariaceae resemble corals in appearance. They are beautiful objects; the plants vary in colour, they may be brown, white, red. There occur several in Canada, all of which are edible. I have eaten only one species and cannot say that it was delicious by any means. After cooking it, it became hard—and it was straw-like in taste. The basidia are produced on the club-shaped tips of this group.

Among the next group, the **Hedgehog Fungi,** there are some edible species. The basidia here are produced upon the spines covering the lower side of the fruiting body. This group of fungi varies considerably in form and size. They may be found during all times of the year, growing on trees or on the ground. Some are fleshy, some leathery, corky or woody. I have no personal experience in eating any of the kinds belonging to this group of fungi. There are, however, several recorded to be edible. The most characteristic genus of the group is **Hydnum,** all species of which are very beautiful and easily recognizable. No mistakes are to be feared when collecting them for the table.

Our next group of Basidiomycetes are the **Tube-Bearing-Fungi** or **Polyporaceae.** Fungi belonging to this group are very common. Nearly all the bracket fungi growing on stumps of trees, wood, railway ties, etc., belong to it. They are easily distinguished from all other fungi by their many-pored lower surfaces, giving to it almost a honey-combed appearance. A considerable number of Polyporaceae grow on the ground and appear in shape much like ordinary mushrooms. They are, however, usually brightly coloured and always show on the lower side the pores by which they are easily recognized. We find quite a number of edible species among them ; indeed, **Boletus edulis** is one of the most palatable of fungi I have ever eaten. This fungus grows generally on the edges of wood, but is also found in open places. The plant is about 2 to 6 inches high, the stem is bulbous, stout, more or less reticulated, and dirty white to pale brown. The glorious cup is from 5 to 8 inches broad and very variable in colour. The surface may be greyish red, brown or ochre. The lower surface shows the round pores or tubes, it is first white, later yellowish or greenish in colour. The flesh is pure white, but it may also be of a slight yellow or greenish tinge. Underneath the cuticle the flesh is somewhat crimson in colour. The variability of the species of Boletus among themselves, which renders an identification often very difficult, is very unfortunate as this same genus contains some very poisonous species.

Our last group of fungi is by far the largest of all. The **Gill-bearing Fungi or Agarics** are distinguished by their fruiting layer which consists of a mass of radiating knife-like folds on which the basidia and spores are produced. For a popular treatise we may group the Agarics according to the colour of the spores, which are very distinctive when seen in a mass, The spores will be found of the following colours: Purplish brown, Black, White, Rosy and Ochre. The colour of the gills does not by any means indicate the colour of the spores and to settle that point a spore print should always be made.

The most typical of gill-fungi belonging to the purple-spored agarics is **Agaricus campestris,** our common mushroom. This fungus is by no means rare, and I have collected it frequently round Ottawa. For the structure that prevails throughout this order of Agarics, an examination of this species will suffice. We may recognise easily the three distinct parts of which all members of this order are composed. At first we can observe the cap and stem; by carefully removing the soil at the base of the latter we can easily discover the mycelium or spawn. If we take the trouble to watch a patch of ground on which we have seen a mushroom growing we will observe that at first a small globose body appears to spring from the spawn. This may not be larger than a pea, but will rapidly increase in size. When it pushes through the soil it will lose its globose form, and become somewhat elongated. In this stage it resembles somewhat a puffball. It is quite covered with a firm membrane. At this time there is no sign of an expanded cap, but a cross section will at once reveal its characters. The gills have been already produced, the cap will be seen contracted and curved towards the stalk, but the whole is enveloped in an outer skin. At a later stage the stalk begins to elongate, but the cap remains still enclosed in the membrane until it slowly expands, and in this act the membrane is torn from the margin of the cap but adheres for a time like a collar round the stem. This collar is one very important character of the various genera belonging to this group. In some Agarics this ring is fairly persistent, in some very fragile and in some absent altogether. The gills of the common mushroom are white at first, then pale rose till they become purple, almost black. If we remember these characters well and keep a careful record of them and of any fungus we may meet, measuring the length and thickness of the stalk, the breadth of the cap, observe the presence of a ring, make a spore print to obtain the colour of them, we will soon be able to distinguish the different members of this group.

The next group are the black-spored Agarics. The commonest of this group are the **Coprini.** They are found generally in groups; their cap is not expanded like that of the mushroom, but is of a conical shape, especially in its young stage. The exterior of the cap is shaggy, or furrowed and from silver grey to a greyish brown in colour. If you have occasion to watch a group of these fungi you may observe a very curious development. The fungi, which at first were quite firm, begin apparently to consume themselves, beginning from the outer edge of the cap. In a little while black inky drops will become noticed all round the edge; still later they begin to fall, staining the grass underneath quite black. This process will go on until the whole cap is consumed. This process of self digestion is very characteristic of the Coprini.

The group of white spored Agarics contains a large number of edible fungi, but also some of the most poisonous known. One of the smaller of this group which is very common in lawns, where it grows in more or less continuous circle, is the little **Marasmius oreades,** commonly referred to as the "fairy ring" mushroom. The cap is expanded rarely much broader than one inch, the centre slightly elevated, rather thin, corky and of buff colour. The gills are rather broad, dull brownish or lighter. The stem is rather hard and fibrous. This little fungus is one of the most delicious and I advise every one interested in the eating of mushrooms, who has gone past this rather insignificant fungus, to stop and pick a pocket full. On cutting them into small pieces, adding a little salt and frying them in butter—and eating them hot on toast, they will agree that it makes an excellent relish. A word may be said about the peculiar habit of its growth. The mycelium produced from a spore, that has fallen upon grass lawn, begins to spread evenly in all directions when a crop of fruiting bodies will be produced in a group. In the centre of the spot, the mycelium having consumed all food in the soil dies, but all around the edges the mycelium can continue to expand into new soil; later a new crop of fungi is produced from the spawn which will now be found appearing on a small circle. This process is continued every year till quite large circles are found. I would, however, advise to check the growth of the fairy ring mushroom on tennis or pleasure lawns, as it kills the grass in patches where it grows.

This group of fungi also includes the very poisonous **fly agaric.** This is a very beautiful plant, but dangerously poisonous. It may be found along roadsides near trees, in open woods, etc. The fungus is readily distinguished by its brilliant colouring. The colour of the cap varies from bright red to yellow or orange, but white forms have been recorded. The cap is generally covered with larger or smaller scales, remains of the membrane which originally enclosed the whole fungus body. A third sign of distinction is formed by the peculiar rough bulb-like swelling at the base of the stem. The gills are white to pale yellowish. The stem is from 4 to 6 inches high; the cap from 3 to 5 inches broad. All species of **Amanita** may be recognized by a very prominent broad ring closely underneath the gills and mainly by the bulb-like swelling at the base of the stem.

Other fungi of this group which are very palatable and common are species of Lepiota. Although closely related to the formerly described Amanita, they may easily be distinguished. The species of this genus have no bulbous swelling at the base of the stem. The most common species is probably **Lepiota procera**, and **L. naucina** is also frequently met with. **Lepiota procera** or parasol mushroom is from 5 to 8 inches high, the cap is 2 to 5 inches broad, the stem is rather thin. The cap is bell-shaped, greyish brown, but the flesh is whitish. The surface of the cap is covered with darker brown scales. The gills are pale rose or whitish and the stem hollow, it may be enlarged towards the base, but does not form a bulb like those found in Amanita species. It grows in pastures, potato fields, along roadsides and may be found from July to September.

Among rosy spored mushrooms no edible species have been recorded with certainty. Perhaps some will be glad to try an experiment.

The ochre spored agarics, however, contain many edible species and none has been reported to be poisonous. **Paxillus involutus** for instance is reported to be very much esteemed in Russia, but the plant occurring in this country is tough and dry when cooked.

WEEDS

W. Lochhead, Macdonald College.

1. From the gardener's or farmer's standpoint any plant which interferes with the growth of the crop to which the field is temporarily devoted is considered a weed. Cultivated plants are sometimes weeds, for they persist in growing in grain fields where they are not wanted. These may be termed **relative weeds;** but more injurious by far are such wild plants as mustard, thistle, ragweed, and the like. Such plants are **absolute weeds,** since under no condition have they any market value.

Many of our noxious weeds were introduced into the country as ornamental or useful plants. Among these are the ox-eye daisy, sweet clover, wild carrot, tansy, chicory, purslane, rib-grass, bouncing bet, and live-forever.

Most of our introduced weeds came from Europe, and succeeded in establishing themselves because they had superior reproductive powers and vitality to our native weeds.

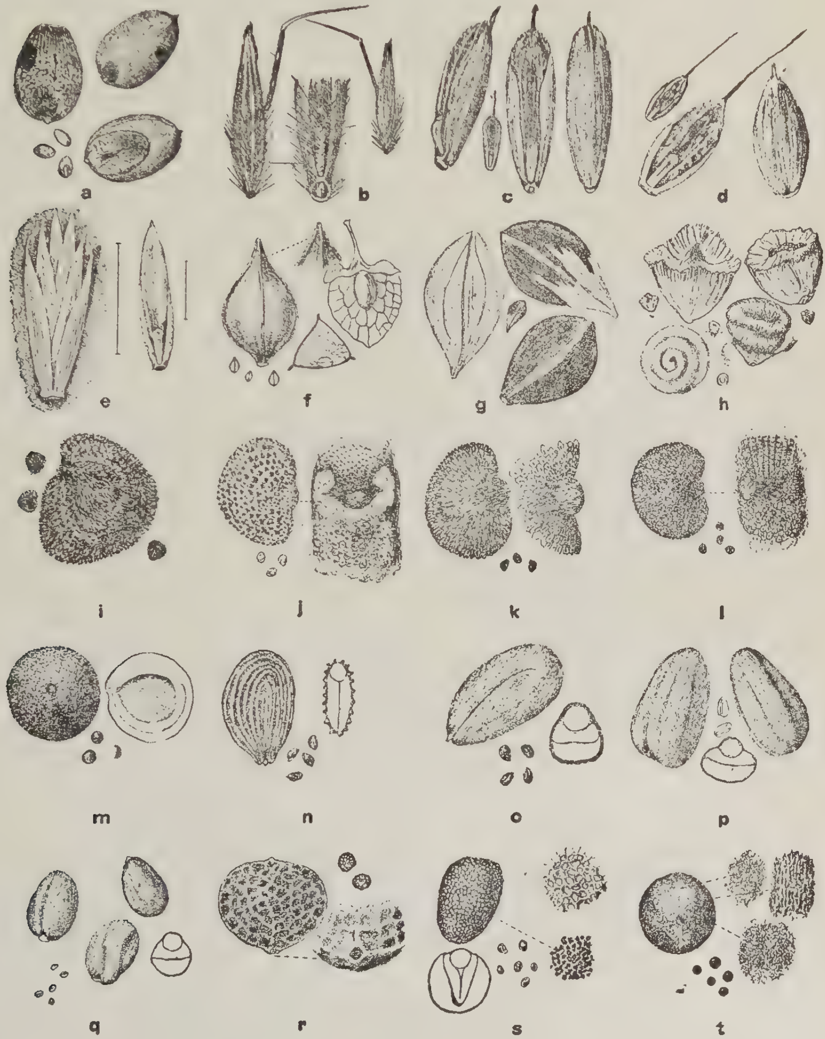
Wild plants must possess certain definite characteristics before they are called noxious weeds by the tiller of the soil. Plants like purslane and daisy fleabane produce an enormous number of seeds. The seed of purslane, wild mustard, and shepherd's purse have great vitality when buried, and survive 15 years or more. The fleabane and red-root ripen their seeds before the cultivated crop is mature. Cockle and chess ripen at harvest, and are threshed with the crop. Quack grass and bindweed have creeping rootstocks. Seeds of mustard and sorrel are hard to separate from the seeds of the cultivated crop. Pigweeds ripen their seed before most people are aware of it. The seeds of thistle, dandelion, and lettuce are carried long distances by the wind. The stems of Russian thistle, white pigweed, and old witch grass break off in winter, and are blown long distances by the wind.

In a general way, we may say that those plants are the most successful weeds (from the weeds' standpoint) which have the ability to live in a variety of soils and exposures, possess rapid growth, have great resistance to frost, drought and dust, are unfit as food for most of the higher animals, can produce many seeds and secure their dispersal.

2. Weeds injure the growing crop in many ways : (a) They absorb a portion of the water-supply in the soil, and consequently lessen the amount available for the crop. Nearly every year there are periods of drought, when the growing crop requires even more water than the soil can furnish. Then the presence of weeds will materially reduce the yield of the crop.

(b) They either occupy the space intended for useful plants, or else crowd the useful plants so that there is not proper access of light, air, and heat. Sometimes the stems of the plants become weak and unhealthy by this overcrowding, and in the case of the slow-growing root-crops the weeds may choke the young plants entirely.

(c) They appropriate a large amount of plant-food stored in the soil which should go to sustain the growing plant.



Noxious weed seeds found in farm seeds: **a**, Sand bur; **b**, wild oat; **c**, chess; **d**, darnel; **e**, quack-grass; **f**, dock; **g** black bindweed; **h**, Russian thistle; **i**, corn cockle; **j**, white campion; **k**, bladder campion; **l**, night-flowering catchfly; **m**, cow cockle; **n**, pennycress; **o**, field peppergrass; **p**, large-fruited false flax; **q**, small-fruited false flax; **r**, ball mustard; **s**, black mustard; **t**, English charlock. (Enlarged and natural size.)—(From Farmers' Bulletin 428 U. S. Dep. Agric.)

(d) They sometimes strangle the plants by entwining them, as in the cases of the field and black bindweeds.

(e) They may feed and harbor injurious insects of many kinds.

(f) They may serve as hosts for injurious parasitic fungi. For example, the rust of mallow injures the hollyhock ; the " shot-hole " of wild cherries may infest the cultivated cherries and plums ; and the rust of many wild grasses may infest wheat, oats and rye.

(g) Some weeds are poisonous to stock, e.g., horsetail, kalmia and cowbane.

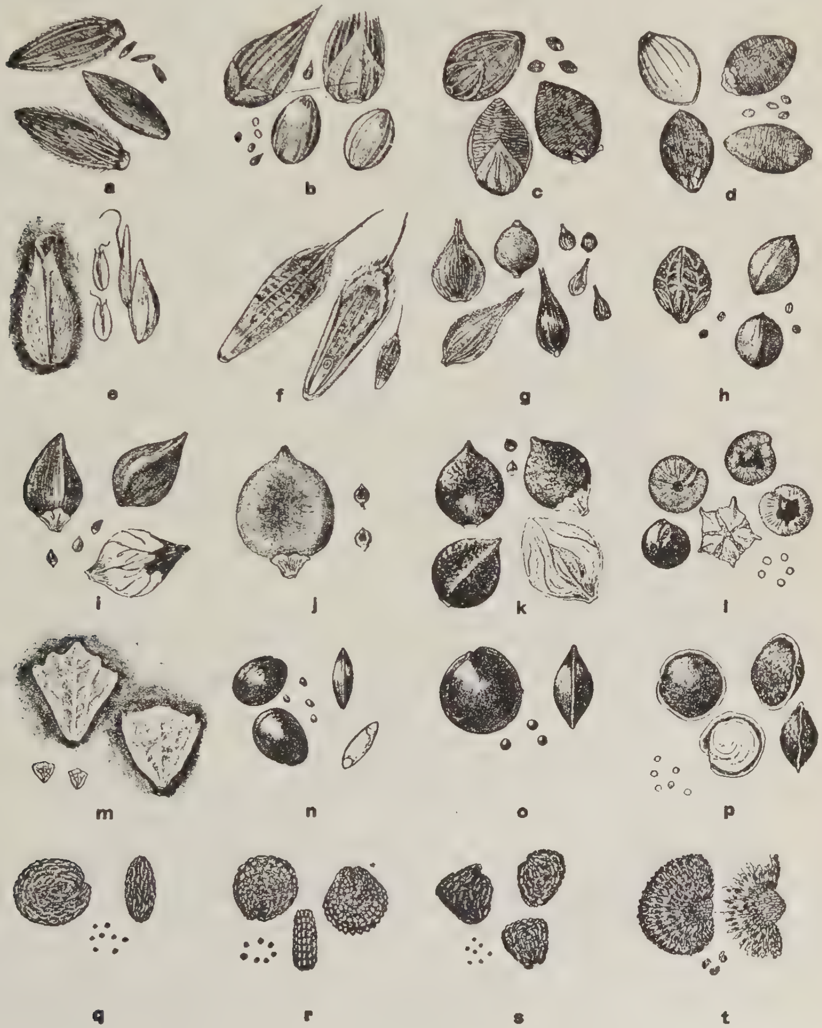
3. Weeds not only injure the growing crops, but also render the land on which they grow more or less unsightly. Roadsides and pastures suffer in this regard, and the market value of many farms is much reduced on account of the unsightliness of weed-infested fields.

4. Weeds are frequently harvested and threshed along with the crop, and the presence of weed-seeds in the grain always lessens the market value of the latter. Moreover, in the case of many weeds, the seeds being burlike cling to the hair and wool of animals, and are a source of much annoyance as well as loss of time to the farmer.

5. Weeds appear on farms and spread from field to field in various ways. Although a few weeds are scattered through the breaking off of underground portions by harrow and plows, yet the very large majority of weeds find a foot-hold because they were planted in the form of seeds. It is a matter of observation that most commercial seeds exposed for sale in seed stores, such as the clovers, grasses, and the common cereals, contain weed-seeds as impurities. There is no doubt that the worst cases of weed introduction may be traced to the purchase of the cheaper grades of clover and timothy.

Some weed-seeds are light and are especially adapted for distribution by the wind. Such are the thistle, dandelion, and prickly lettuce. Some weeds, such as the blue-weed, cleavers, hound's tongue, burdock, are spread through the agency of animals. Their fruits have hooks and cling readily to the hair or wool of animals. Some weeds, like old witch grass and Russian thistle, break off near the ground, and the seeds are blown along over the hard earth, or the frozen crust of snow, sometimes for long distances. Spring freshets sometimes carry weed-seeds from one farm to another. Birds, too, are instrumental in scattering certain weed-seeds over large areas.

One of the most common methods of distribution of weeds is through use of manure which contains the screenings and weed-seeds of the barn-floor. Moreover, when the hay, which is fed to the stock, is badly infested, many weed-seeds escape without injury and find their way to the manure pile, to be spread sooner or later over many fields of the farm. Threshing machines are also responsible for the introduction of many weeds from neighbours' farms.



Other weed seeds commonly found in farm seeds: **a,** Crab-grass; **b,** witch-grass; **c,** yellow foxtail; **d,** green foxtail; **e,** velvet grass; **f,** soft chess; **g,** sedge; **h,** sorrel; **i,** knotweed; **j,** pale knotweed; **k,** lady's-thumb; **l,** lamb's-quarters; **m,** wild saltbush; **n,** rough amaranth; **o,** spreading amaranth; **p,** wild spurry; **q** and **r,** chickweed; **s,** mouse-ear chickweed; **t,** forked catchfly. (Enlarged and natural size.)—(From Farmers' Bulletin 428, U. S. Dep. Agric.)

6. A knowledge of the life-history of weeds is the first essential in a scheme for their eradication, for all weeds should not be treated alike. Some, like the mustard and ragweed, complete their life from seed to seed in a single year, and hence are called **annuals.** Soon after the seeds ripen the plants die, so that if annuals are prevented from ripening their seeds they must disappear altogether.

There are certain weeds called **winter-annuals,** such as pigeon-weed, wild flax and chess, which are intermediate between annuals and biennials. They germinate in the fall, pass the winter unharmed in the seedling form, and seed early the next summer.

Some weeds require two years to complete their life. During the first year the seed germinates, and a short leafy stem is developed. The energies of the plant during the first growing season are mainly devoted to the production of food material which it stores up in the large tap-root. During the second season, the plant produces flowers and seeds. Such plants are **biennials,** and among these are mullein, blue-weed, wild carrot, wild parsnip, burdock, and some thistles.

Some weeds live many years, and are therefore **perennials.** **Simple perennials,** such as ox-eye daisy, chicory, and plantain, are capable of multiplication by seeds only, while **creeping perennials,** like couch grass, Canada thistle, bindweed, and sow-thistle, have the additional power of reproduction from buds on creeping underground rootstocks.

Following are the most important weeds of the farm and garden arranged according to their life duration :—

Annuals.—Purslane, wild oat, lamb's quarters, mustard, pigweed, corn cockle, ragweed, dodder, shepherd's purse, chickweed, chess, pigeon-weed, or red-root, wild flax, pepper-grass, penny-cress.

Biennials.—Mullein, hound's tongue, sweet clover, teasel, burdock, bull thistle, wild carrot, white cockle, blue-weed, corn flower.

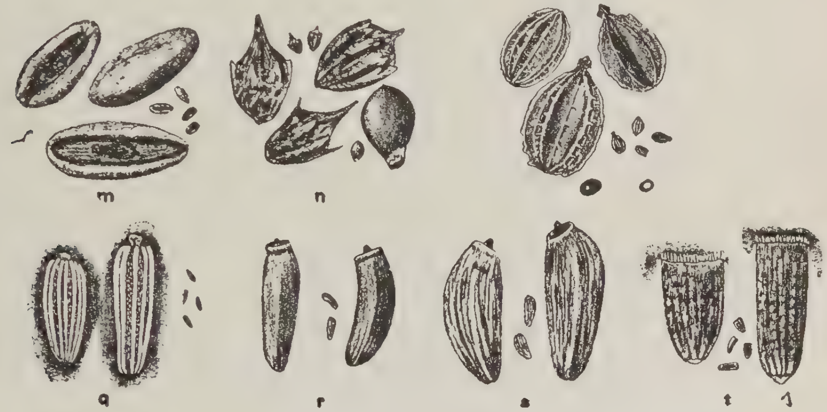
Perennials.—Canada thistle, perennial sow-thistle, couch grass, toad-flax, mint, field bindweed, bouncing bet, spurge, chicory, golden rod, plantain, mallow, aster, vervains, dock, sorrel, fox-tail, bladder campion.

7. The habit of growth of weeds should also be carefully studied. Most annuals have a shallow, much-branched root-system, and produce enormous numbers of seeds. In some cases, the stems are **erect,** as with the mustard ; in others the stems are **prostrate,** as with the chickweeds, and knot-grass.

Most biennial weeds are **deep-rooted** plants, such as the burdock, carrot, bull thistle, and blue-weed.

Among perennial plants, as already noted, there are simple erect forms and the creeping root-stock forms. The latter may be divided again into **the shallow-rooted,** such as, couch-grass ; and the **deep-rooted,** such as the Canadian thistle, perennial sow-thistle, and bindwood. On the root-stocks are dormant buds which send up new shoots under such favorable conditions as warmth and moisture, or when the root-stocks are severed from the main plant by cultivation. It is obvious, then, that creeping perennials are the most difficult to eradicate.

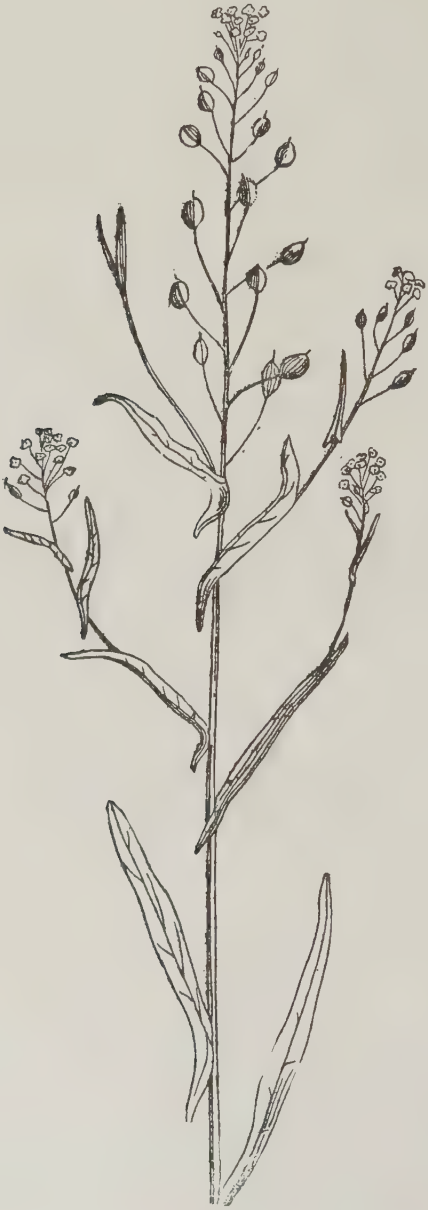
From the preceding remarks, it will be seen how weeds differ widely among themselves as to their life-history and habits of growth. Some reproduce altogether by seed, others by roots or rootstocks ; some are scattered by winds, others by animals or through the agency of man himself ; some have a deep root-system, while others have a shallow root-system ; some live but one year ; some two years, and others live many years.



Other weed seeds commonly found in farm seeds: **m,** Rib grass; **n,** ragweed; **o,** wild carrot; **q,** ox-eye daisy; **r,** Canada thistle; **s,** bull thistle; **t,** chicory.—(From Farmers' Bulletin 428, U. S. Dep. Agric.)

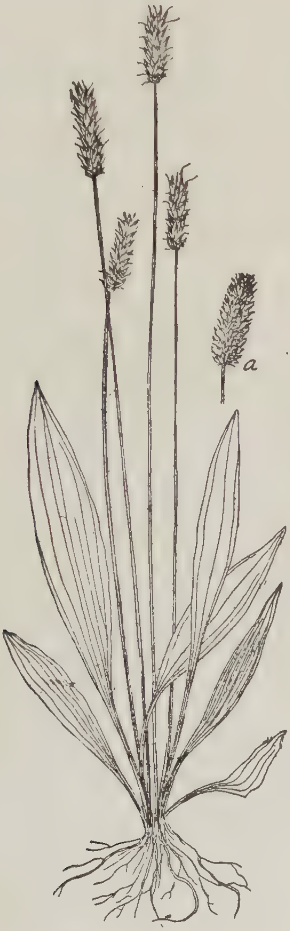
8. While it is true that nearly every species of weed requires individual treatment, yet there are certain general principles which can be applied in the extermination of all forms: (a) **Weeds should not be allowed to seed.** This principle applies specially to annuals and biennials, which reproduce by seed only, and die soon after the production of the seed ; (b) **Only clean seed should be sown ;** (c) The **seeds which have matured** and **fallen to the ground** should be looked after carefully. The best time to deal with these is immediately after harvest, when the ground should be cultivated so as to force the seeds to germinate. A week or two later, the

seeds which are then up a few inches may be readily destroyed by harrowing; (d) Most annuals as well as young biennials and perennials are destroyed by this simple method of **burial by the plow,** or by the exposure of their roots



False Flax.

by the harrow. Well-established biennials and perennials are not killed in this way, however, because, in the latter, the dormant buds on their underground portions send up new shoots, and in the former the food supply in the tap-roots enable them to do likewise ; (e) The **cutting of weeds by the spud, scythe, or hoe,** when done properly and at the right time, is a very effective method of eradication. Plants feed through their leaves and roots, and if the leaves are repeatedly destroyed, plants, no matter whether they are annuals, biennials, or perennials, must die of starvation. The mowing of weeds should be done early in the season while they are young A second operation is usually effective in killing the plants, if they are annuals.



Buckhorn or Narrow-leafed Plantain.

Weeds may be cut either below or above the seed leaves, or the crown of the root. The former method is the more effective with annuals and biennials, for seldom will the underground portion send out new shoots. Burdock, wild carrot and mullein, if spudded early, will rarely recover. If weeds are cut above the seed leaves, the latent buds at or near the crown develop, and produce many stems instead of one. Biennials cut in this way at the close of the first season are but little injured, for their store of food is already laid up in their roots.

Perennials with creeping rootstocks are not readily killed by spudding, either below or above the seed- leaves. They must either be starved, which is done by forcing them to send up new leaves and shoots, and preventing them from storing up new food by their leaves, for two or three months during the growing season, or else their roots must be brought to the surface by cultivation, where they will die from exposure.

(f) By a suitable rotation of crops, and the growth of hoed crops and clover, weeds are held in check. Hoed crops are invaluable for cleaning fields, as there is then an opportunity for fighting weeds during the whole season of growth. Clover crops not only smother weeds, but also allow of the cutting of the weeds before they ripen their seeds.

9. A few of the worst weeds will now be discussed, their characteristic habits noted, and the best means of destroying them stated concisely.

Wild Mustard, or **Charlock,** or **Herrick** (Brassica sinapistrum) is an annual with an erect, rough, branching stem, bearing bright, yellow flowers (cross-shaped). The pods are long and knotted, and terminate in a two-edged beak. The seed resembles turnip or rape seed, and may retain its vitality many years when buried in the ground. This weed is usually found in grain crops sown in the spring. The methods of eradication are : (a) Spray with a 2 per cent. solution of blue-vitriol (8 pounds in 40 gallons of water) during early June, just before the plants come into bloom. (b) Gang-plow after harvest to germinate the seeds, after a week harrow to destroy the mustard seedlings, repeat, put in hoed crop next season and cultivate thoroughly during the crop and after, put in spring grain and seed down to clover.

Ragweed (Ambrosia artemisiaefolia) is another annual. It has a branched, hairy stem with finely divided leaves. The flower-heads are green and not at all conspicuous. The seeds ripen late in the season.

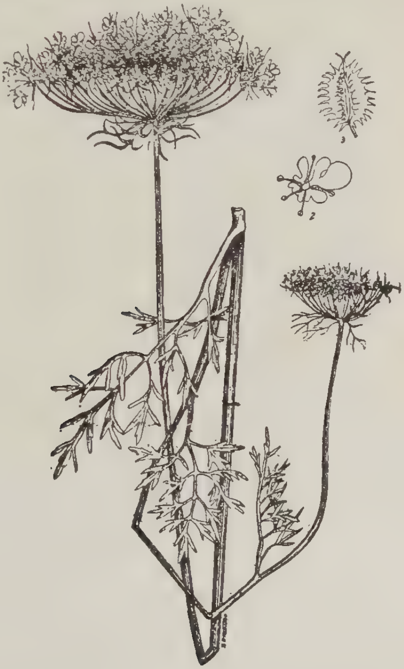
The stubble should be cultivated after harvest, and at intervals in the autumn. This will prevent the seeds ripening. Follow next season with a hoed crop, avoid sowing late maturing crops.

Wild Oat (Avena fatua) is an annual, resembling the cultivated oat. At the base of the grain are brown hairs, and at the tip is a rough, bent and twisted awn. The seeds have considerable vitality when buried. Cultivate the infested land frequently during the summer, and sow to fall wheat and seed down. The sod should in two or three years be broken up in June, and cultivated thoroughly before sowing to fall wheat and seeding down again. Or cultivate right after harvest through the autumn and follow with a hoed crop, after which, the following spring, sow without plowing and seed down to grass.

The plan is to omit cereal crops from the rotation, and to substitute hay, pasture, or hoed crops.

White Cockle (Lychnis vespertina) is a biennial, with hairy, branching stems. The flowers are white and dioecious ; and there are sticky hairs near the top joints and flowers. This weed is introduced mainly as an impurity in seeds.

To eradicate give the same cultivation as outlined above for mustard.

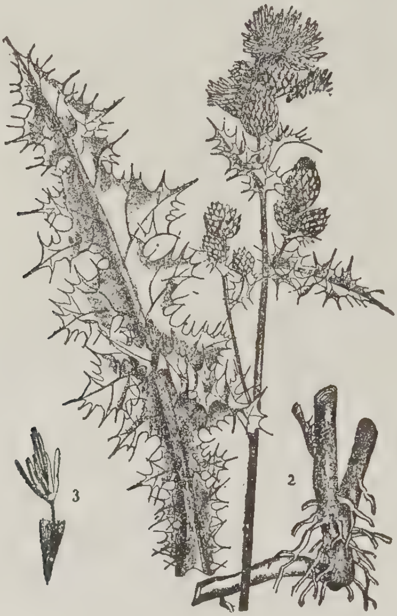


Wild Carrot—a biennial pasture weed.

Wild Carrot or **Bird's Nest** (Daucus carota) is a biennial with a deep, strong tap root, a bristly stem, and much divided leaves like the cultivated carrot. The clusters of flowers form themselves into bird-nest cavities. It occurs chiefly on roadsides and in pasture fields.

Spudding before blossoming time will do much good, but, if badly infested, the field should be plowed and cultivated, and treated to a hoed crop.

Canada Thistle (Carduus arvensis) is a perennial with deep underground rootstocks. The heads are oval and purple. The seeds are provided with a tuft of hairs, and are blown long distances by the wind.



CANADA THISTLE.
This weed, with Quack Grass, Horse Nettle and Morning Glory, is one of the worst. They are all bad becaus they live from year to year, produce seed and spread by rootstocks.

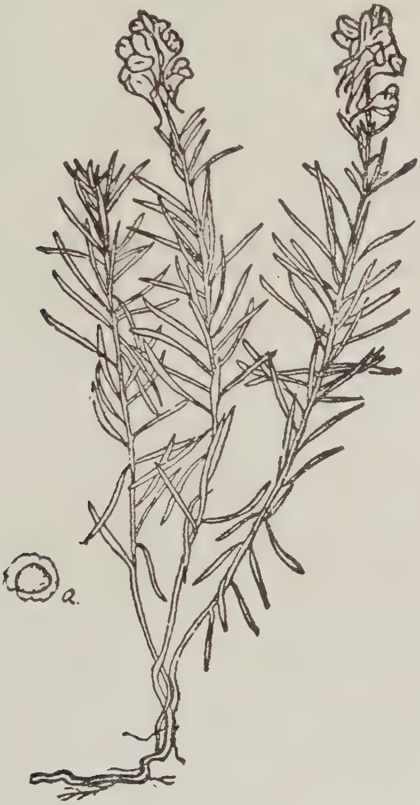
There are several methods of eradication, but all are based on the plan of shallow after-harvest cultivation, continued until winter sets in, to force the seeds to sprout, and to drag the rootstocks to the surface so as to kill them by exposure. Next season, this treatment should be followed by a cereal crop, seeding down with clover.

Perennial Sow-thistle (Sonchus arvensis) is a perennial with deep, creeping underground stem, filled with a milky juice. The flower-heads are yellow, and dandelion-like. The seeds have a tuft of down and are readily wafted considerable distances by the wind.

The treatment outlined above for the Canada Thistle will keep this weed in subjection.

Ox-Eye Daisy (Chrysanthemum leucanthemum) is an erect branching simple perennial. It is most troublesome in hay and pasture land.

The land should be broken up before the seed has matured, and given good cultivation in the autumn ; next season put in hoed crops, then the following season put in cereal crops, and seed down to clover. Plow up after one crop is taken off, and before any daisies have seeded.



Butter-and-Eggs or Toadflax.

Field Bindweed (Convolvulus arvensis) is a perennial with deep, creeping underground stems, which have dormant buds. This weed is perhaps the most difficult of all farm weeds to eradicate. The infested area should be cultivated by itself every week or ten days during the summer, a corn or hoed crop should follow this the next season.

A PLEA FOR THE ENGLISH SPARROW

Rev. Thomas W. Fyles, D.C.L.

Of all new-comers who in the nineteenth century were brought to this continent, surely the boldest, the hardiest, the most adaptable, the most prolific was the English sparrow.

About the year 1850 a very craze seems to have come over the minds of men in America for the importation of sparrows. We are told that the people of Philadelphia went to the trouble and expense of procuring one thousand of the birds. New York, Brooklyn, Boston, Rochester, Cleveland, Salt Lake City and other places in the United States had them brought out directly from Europe. The Honourable Col. W. Rhodes, Minister of Agriculture, who resided at Quebec, introduced them to that city in 1864.

Besides the idea that sparrows were useful, the inducements with old country settlers in Canada to protect and care for the little strangers were : a sense of the lack of winter birds to enliven their surroundings, and a recognition of the sparrows as familiar acquaintances of former days and distant scenes.

Now there is a tendency, in the States especially, " to go back " upon the sparrows, and to regard them as nuisances. Methods for their extermination are advocated : the wholesale destruction of their nests and eggs, poisoning, shooting, trapping.

The accusations against the sparrows are these :—(1) They are untidy and offensive in their nesting habits. (1) They pick off the buds of fruit trees. (3) They damage the fruit. (4) They eat the ripening grain. (5) They drive away other birds.

It should be remembered that the sparrow is especially a town bird.

The Macouns in their valuable catalogue of Canadian Birds (p. 456), say :—" it destroys an enormous quantity of noxious weeds in waste grounds and vacant places in cities and their suburbs, by eating their seeds in September, October and November, until the snow comes, when it takes to the streets."

Of the objections enumerated above, the first may be easily met : the nests of the birds may be dislodged from unsuitable places about the dwelling with but little trouble and loss of time.

Other birds untidy in their nesting habits have been tolerated. I call to mind the old church of a country parish near the St. Lawrence River. It stood apart from the other buildings, and it had wide eaves. Under these, some hundreds of cliff-swallows (Petrochelidon lunifrons), every season built their mud nests closely packed. The winter storms brought down the nests in masses, and their crumbling materials were piled around the building.

The clergyman would not allow the birds to be disturbed. He thought of the verse, " The sparrow hath found her a house, and the swallow a nest for herself, where she may lay her young, even thy altars, O Lord of hosts, my King and my God."—Ps. LXXXIV, 3.

As regards the accusations numbered 2 and 3, the evidence collected by Mr. Walter B. Barrows in Bulletin 1, U.S. Dep. of Agr., Division of Economic Ornithology and Mammalogy, is extremely contradictory. Thus :—Mr. Henry C. Hallowell of Sandy Spring, Md., asserts (page 60), " We can certainly say we have never had a greater abundance of cherries, currants, gooseberries, pears, etc., than since the sparrows came." And Judge John C. Ferriss, of Nashville, Tenn., says (p. 66), " It is a blessing to any community that raises vegetables."

On the other hand, J. T. Bodkin, of Patriot, Ind., writes (p. 63), " It is injurious to fruits and vegetables, especially the latter. Last year it ate up my young peas completely, and also preyed on lettuce, beets, strawberries, etc., while young and tender." And J. B. McKinney, Newburgh, Ind., (p. 59), " It destroys cherries, currants, apples, pears and any small fruits."

I shall not attempt to reconcile these contradictory statements ; but I must say that I have never known, in England or Canada, damage such as mentioned, to be done by the sparrows. In the old land fruit has to be protected against thrushes and blackbirds ;* and in this the robin and waxwing are mischievous. The latter, from its love for cherries, has received the name of " Cherrybird."

Mr. Thomas Chalmers, of Holyoke, Mass., in the Bulletin above mentioned says (p. 60), " I have not known it to injure fruit or vegetables. One robin and one Baltimore oriole will destroy more cherries and green peas in a day than the whole sparrow creation in an eternity."

*Tennyson's lines to "The Blackbird" will be remembered :

"The espaliers and the standards all
Are thine ; the range of lawn and park.
The unnetted blackhearts ripen dark,
All thine, against the garden wall."

It cannot be doubted that, all through the breeding season, the sparrow feeds its young with insects. Canker-worms, cabbage-worms, cut-worms, currant-worms—all bad C's—are taken by hundreds in the course of the season, to the great benefit of the fruit-grower and gardener. **We may say that in the summer-time the sparrow does good by destroying noxious insects.**

On the 14th of June last year, an exceedingly hot day, a remarkable sight was witnessed in the streets of Hull, P.Q.: myriads of large black ants of the species **Formica pennsylvanica** DeGeer filled the air, and soon were crawling everywhere ; but they were not long in evidence. The sparrows found them to their liking and glutted themselves upon them. Next day hardly an ant could be found.

Frequently in the summer, in all places along the river, we have swarms of Neuropterous insects. Such times are high festivals for the sparrows. The birds may be seen in our streets filled to repletion, and so indolent that they will hardly take the trouble to move out of the way of the pedestrian.

And later in the season the sparrow does good. There were three huge white willows in the yard of my home at Levis. They were greatly affected by the saw-fly **Messa hyalina** Norton. This insect makes an incision here and there in the young leaves of the willow, and deposits an egg in each wound. Around the egg a kidney-shaped gall is formed, and in it the larva from the egg finds its dwelling-place and food. As many as twenty galls may sometimes be seen on one leaf. The larva becomes " full-fed " about the time of the fall of the leaf, when it bites a way from the gall, drops to the ground, buries itself, then spins a cocoon in which it undergoes the pupal change. In the spring the insect appears as a perfect fly.

One autumn day my attention was drawn to the actions of an assembly of sparrows on the trees I have mentioned. The birds were clinging to the twigs, cracking the galls on the leaves, and feeding on the larvæ which they contained.

This will help us to understand why the birds are sometimes seen pecking at the buds and flowers of fruit trees ; they are preying upon the bud-worms, palmer-worms, leaf-crumplers, etc., and to these insect pests the loss in the after crop of fruit should properly be ascribed.

As the sparrows have increased, injurious insects have decreased—the Bot-flies among them.

The Horse Bot-fly, **Gastrophilus equi fabricius,** hovers around the horse and affixes its eggs to the animal's fore legs. There they soon hatch.

The young larvae by their movements causing irritation, the horse licks them off, and they pass into its stomach with its saliva. There they attach themselves, and thrive, to the detriment of the animal. I have seen a portion of the stomach of a horse that had died of the bots, on which, fastened by their nozzles, the bots were so numerous that they touched on all sides. When full grown the creatures are voided with the natural dropping of the horse.

In search of these larvæ, and of partly digested grain, the sparrows promptly scatter the horse manure, which then quickly dries up and loses much of its offensiveness.

That, in the harvest time, the sparrows, with bob-o-links and other birds, should resort to the grainfields is to be expected ; but that is the proper time for thinning out their numbers.

Few people know that the plump little sparrow is as good eating as the ortolan, the snow-bunting, or the quail. A farmer's boy with a shot-gun can take toll of harvest-field feathered invaders, drive away the rest, save the grain, and secure the provision for a savoury meal.

In the Province of Quebec we have comparatively few winter birds. Around country homesteads the blue-jay (**Cyanocitta cristata**), the chicadee (**Parus atricapillus**), the tree-sparrow (**Spizella monticola**), and a few others may occasionally be seen. Large flocks of the snow bunting (**Passerina nivalis**) visit our meadows when the breaking up of the cold weather is near. Some winters ago a flock of pine grosbeaks (**Pinicola enucleator leucura**) lit in the trees round my house at Levis, and, among the black timber in Brome, I have seen the crossbill (**Loxia curvirostra minor**) in considerable numbers during the cold weather. But the English sparrows are now domesticated amongst us. We see them in our waste places picking at the heads of plantain, and other weeds projecting from the snow. We see them in our streets scattering the droppings from the horses. We see them on our verandas waiting for the crumbs that tender-hearted housewives throw out to them. They enliven the dull outlook, and we should greatly miss their presence were they taken away. **We cannot say they are hurtful in the winter time.**

It seems to me that the last named accusation (No. 5) cannot hold good.

England is the land of sparrows, and yet, if there is one country richer in song-birds than another, England is that country. There, even now, "the time of the singing of birds is come," and every copse and plantation is jubilant with the voices of the feathered choir.

We can understand the chagrin of a man who, with a view to attracting swallows, has been to the pains of erecting a pole, with a handsome bird-house surmounting it, on finding that the sparrows have taken advantage of his labours. He probably had not remembered that the sparrows mate before the swallows come.

If the sparrows could reason and talk, they would say, "How kind of this good man to provide us with such comfortable quarters ! We thankfully take possession of them and will hold them against all comers. As for the swallows, they can manage as their ancesters did before the Gauls and Britishers came, and when our own kind was unknown in the land."

I live in the outskirts of the city ; and in summer I spend much of my time in the woods and meadows near. I frequently discover trap-cages with call-birds, set for the purple finch, the Canadian goldfinch, the bobolink, etc. I often meet a boy with a shot-gun, attended by six or eight youthful admirers, searching the woods for vireos and other small game.

Trap-cages, shot-guns, air-guns and catapults are diminishing the numbers of our song birds : **but the sparrows get the blame.**

SOME FIELD EXPERIMENTS OF A POTATO ROT

J. F. Monroe, Macdonald College

It is not my intention to enter upon a discussion of this disease, the organism which causes it, or any treatment. Rather, to give a short account of the field experiments carried on by the Department of Horticulture.

Twenty-nine varieties were planted on the 18th of May. These were planted for the purpose of carrying on a variety test. The soil selected being loamy and fairly uniform in texture.

The potatoes were cultivated frequently enough to maintain a surface mulch and to conserve as much soil moisture as possible. Cultivation stopped, and the potatoes were hilled slightly when the tops had grown to nearly touching between the rows.

The plants were sprayed five times throughout the season, the first spraying being with an arsenical poison and subsequent sprayings with poisoned Bordeaux. This proved sufficient to keep the potato beetle in control and to prevent blight. The tops received but very little, if any, check from infestations of insects and fungi during the growing season.

The season being evidently favorable to the development of the rot, it was decided to keep record of the marketable, diseased, and small tubers. This enabled us to make a comparative test of the per cent. diseased in the different varieties, along with the variety yield.

The accompanying table gives a list of the varieties, with the yield per acre, the number of bushels per acre of marketable, small and diseased, and the per cent. of diseased.

Yield per Acre

	Marketable	Small	Diseased	Total	Per cent. Diseased
Early Six Weeks	22	16.5	82.5	121	68.2
Immigrant	32.2	9.9	80.3	122.4	65.6
Early Rose	82.5	27.5	203.5	313.5	64.9
Extra Early Hero	43.7	26.7	126.5	196.9	64.2
Carman No. 1	79.8	16.5	110.0	206.3	53.3
Irish Cobbler	82.5	27.5	89.37	199.37	44.8
Everett	45.5	16.5	48.1	110.	43.7
Early Sunrise	156.2	37.4	149.6	343.2	43.5
Nebraska	60.5	22	49.5	130	37.5
Eldorado	68.7	16.5	49.5	134.7	36.7

Yield per Acre—Continued.

	Marketable	Small	Diseased	Total	Per cent. Diseased
Green Mountain	96.2	13.7	68.7	178.6	34.5
Pinnacle Beauty	23.9	33.5	28.9	86.3	33.4
Woodbury White Rose	74.2	33.	49.5	156.7	31.5
Early Petroskey	202.7	26.7	71.5	300.9	23.7
British Queen	119.6	24.7	34.4	178.7	19.2
Imp. Early Ohio	68.2	35.7	20.9	124.8	16.7
Suttons Prolific	118.8	31.	27.5	177.3	15.5
Factor	93.5	24.7	20.6	138.8	14.8
Eureka	185.3	44.	34.4	263.7	13.
Dalmeny Beauty	85.8	22.	15.4	123.2	12.5
King Edward	187.	13.7	22.	222.7	9.8
Veribest	228.2	27.5	......	225.7	....
Satisfaction	209.	11.0	......	220.	....
Findlay's Star	132.	41.2	......	173.2	....
Norton Beauty	68.8	22.	......	90.8	....
Crofter	88.	41.2	......	129.2	....
Solamene Commersoni	88.	....	......	88.	....
White Giant	63.2	24.7	......	87.9	....
Epicure	37.1	22.	......	59.1	....

ADAPTATIONS BETWEEN PLANTS AND INSECTS

W. Lochhead, Macdonald College.

The living world of nature has been likened to a web with its warp and woof, composed of an immense number of threads which interlink. If one thread be pulled out many other threads will be loosened. Every part is delicately bound together in an intricate system, and a disturbance at one point is felt frequently at other and remote parts.

In the course of long ages while plants and insects have been evolving there has been developed a mutual adaptation, so that they are in many cases fitted to one another. They have come gradually to be interdependent on account of the long periods of alternate influencing and mutual perfecting. It is about this mutual adaptation that I would talk to-night. It is an old subject, yet ever new. It is that phase of Biology that appeals most to the true nature student who loves to ramble with mother nature and to learn her many secrets. Strange to say, this special branch of study is not much more than 100 years old. The pioneer investigator was Christian Konrad Sprengel, a Berlin naturalist. He published in 1793 a book entitled " The Secret of Nature discovered in the Structure and Fertilization of Flowers." Sprengel showed clearly the reason for the insect visits to flowers, and their effect on the flowers ; the adaptations for the purpose of securing pollination ; and the general habit of cross-fertilization among plants.

Strange to say also, this classic work of Sprengel's remained for nearly seventy years almost forgotten until it came into the hands of Darwin who at once saw the immense importance of the work.

Darwin, however, placed the study of the " Web of Life " on a new and higher plane by his remarkable researches along many branches of plant and animal life. His great work on " Cross and Self Fertilization of Plants " will always remain a classic along with his earlier work " The Origin of Species."

It remained for Darwin to prove experimentally the utility of cross-fertilization, and to show that the adaptations which ensure cross-fertilization were the result of Natural Selection. Numerous investigators since his time have added to our knowledge of adaptations, but their work simply emphasizes the great principles which he formulated. It has been shown that there are " all grades of association between plants and insects from the most casual contact to mutual dependence, and that there are all grades of fitness on both sides. Further, that while the adaptations are often wonderfully intricate and fit, they rarely work perfectly and may even wholly miscarry." (Needham, General Biology, p. 35).

General Considerations

Insects. Insects visit flowers for the purpose of obtaining either pollen or nectar, or both. There are many kinds of insects with many peculiarities of structure. Generally speaking, there are five orders of insects that visit flowers : Diptera, Hymenoptera, Coleoptera, Hemiptera and Lepidoptera. The peculiarities of these orders are well known to you and need not be dealt with here. Specialized flowers, as a rule, are visited by insects with a particular structure.

Flowers. Generally speaking, flowers that are visited by insects are colored. Different colors attract different insects. Flies visit dull yellow, brown, or dark purple flowers, while bees and butterflies are attracted by red, blue or violet flowers.

Odors, perhaps, are more powerful agents of attraction than colors, as it has been shown that insects are unable to distinguish objects clearly more than five or six feet distant. However, we should not dogmatize too much on this point, for it is recognized that flowers that bloom at night are usually white or yellow, and are more sweet-scented than those that open during the day.

The position of the nectar glands and nectaries of flowers is various. They are often protected by spines or glandular hairs or hidden at the bottom of deep passageways or tubes, so as to be out of reach of those insect visitors that may be called intruders.

Not all colored flowers bear nectar. The yellow fringed loosestrife, for example, produces abundant pollen, and is visited by little black pollen-eating bees which unconsciously convey pollen to the stigma of the flower.

Some simple regular flowers, like those of the yellow buttercup, secrete nectar at the base of each petal, but the flowers in such cases are readily accessible to almost all visitors.

With regard to the position of the flowers four types of plants are recognized :

1. Plants whose flowers open in fine, but close in wet weather. Examples : Hieracium, Centaurea, Crepis, Rosa, Draba, Tulipa, Crocus, Gentiana, Datura, etc.

2. Plants whose flowers are open, on erect or sloping stalks in fine weather, but on bent stalks in wet weather. Examples: Rubus, Fragaria, Geranium, Violets, Anemone, Buttercup, many Crucifers, Scrophularias, etc.

3. Plants whose flowers are protected from rain by special curving of the main floral axis. Examples : Bidens, Galinsoga, some Crucifers, Corydalis, etc.

4. Plants whose flowers open in fine weather, but both close and bend their stalks in wet weather. Examples :—Sonchus, Convolvulus, Oxalis, Epilobium, Solanum, Tulipa, etc.

Cross Fertilization Devices

Plants have various methods or devices for ensuring cross-fertilization. These are well known, and a mere summary will suffice here :

1. Plants are often **diclinous,** i.e., with staminate and pistillate flowers separate, either on the same plant as with pines and hazel, or on different plants, as with willow and hop.

2. Flowers are often **dichogamous,** i.e., the stamens mature either before or after the stigma of the pistil is ready to receive the pollen. In sunflower, daisy, carrot, bean, vetch, in fact in most leguminosae, compositae, labiatae and umbelliferae, the stamens mature before the stigmas. In the apple, pear, plantain and most grasses the stigma matures before the pollen.

3. Some flowers are **dimorphic,** or even **trimorphic,** as in Houstonia, Primula, and Lythrum.

4. Many flowers show in addition special contrivances for bringing about insect fertilization, as Asclepias, orchids, etc.

5. Many flowers are **self-sterile** as regards their own pollen, e.g., buttercup, pear, clovers, kalmia, etc.

6. With some flowers foreign pollen is **prepotent** over home pollen.

Hymenopterid Flowers

(a) Bee flowers as Trifolium repens
(b) Bumble bee flowers as Trif. pratense, Aconite } Calamintha.
(c) Wasp flowers, as Scrophularia nodosa
(d) Ichneumon flowers as Listera ovata
Flowers usually zygomorphic—red, blue and violet.

Lepidopterid Flowers

(a) Butterfly flowers, usually red as } Crocus
(b) Moth flowers, usually white as

Dipterid or Fly Flowers

(a) Nauseous flowers, by carrion and dung flies, Saxifraga, Rhamnus Ruta.
(b) Pitfall flowers as Asclepias, Cypripedium.
(c) Deceptive flowers, as Parnassia.
(e) Hover-fly flowers.

General Conclusions regarding Specialization of Flowers. 1. The more specialized a flower, i.e., the more complex its structural arrangements and the more deeply seated its nectar—the less are its insect visitors indiscriminately drawn from the entire insect fauna of a district, and the more do they belong to one or several similar species adapted to pollination.

2. "The flatter and more superficial the position of the nectar, the more varied are the visitors in different regions, and the more are they indiscriminately drawn from the entire insect fauna of the region in question."—(Knuth, Vol. 1, p. 196.)

Law regarding the Attraction of Insects to Flowers. " Attraction from considerable distances is certainly effected for the most part by the odor of the flowers, which indicates the direction for flight. When the insects approach nearer (1-2 metres) the colors of flowers attract them further ; and when they finally settle, the lines and points long since described by Sprengel serve to point out the way to the nectar."—(Knuth, Vol. 1, p. 211.)

Ants are notorious robbers of pollen and nectar, without giving anything in return for the material taken.

Accordingly we find that many plants protect their flowers against undesirable guests or visitors. Some of these protective schemes are :

(1) The stems and flower stalks are often sticky.
(2) The flower stalks are often quite slippery.
(3) The presence of water reservoirs along the stem.
(4) A sticky, hairy or a slippery nodding calyx.
(5) The corolla with closed throat.
(6) The stamens and pistil cover the nectaries.
(7) The presence of long calyx or Corolla tube.
(8) The presence of long spurs with nectar stored at the bottom.

Pollination of Yucca by Pronuba.—The female moth enters the open flower at night, and carries the pollen gathered up into a ball to another flower, into whose ovary she deposits her eggs. She places the ball of pollen in the funnel-shaped stigma so that pollination results. The young larvae feed on some of the young seeds, and when full grown pupate in the earth. Without this pollination no seeds are formed.

Pollination of Iris.—The stamens lie in pockets between the petals and the petal-like styles. Near the top of the style is a shelf, the upper surface of which is stigmatic. The nectar lies at the junction of the petal and stamen. When the bee alights on the petal platform in search of nectar it brushes the pollen on its back against the stigmatic surface of the shelf of the style. Then it collects more pollen on its back as it descends to the nectar pouch. When the bee backs out its back comes into contact with the lower surface (non-stigmatic) of the style shelf, and self pollination is prevented.

Dr. Needham makes a list of over sixty species of insects that frequent the Iris. Besides bumble-bees, two small bees and a few syrphids are important pollenizers.

Pollination of Milk Weed.—When the honey bee or wasp crawls over the peculiar flowers its legs are very apt to slip into a fissure leading to the discs of the anthers. The discs carry a pair of pollen masses which become detached and adhere to the legs of the insect. As the insect visits another milkweed flower the pollen discs are readily introduced into the stigmatic chamber and pollination is effected.

Noctuid moths also often haunt milkweeds.

Pollination of Orchids.—The orchids form a family of plants with a great variety of flower forms, which are elaborate traps for effecting cross pollination.

In the Lady's Slipper orchid one of the petals forms a pouch or slipper which contains the nectar. There are three openings into this slipper, one in front, the usual mode of entrance, and two behind, one on each side of the overhanging trowel-shaped style, past the anther sacs. The insect finds its way inside quite readily, but must pass out by one of the smaller openings behind. In doing so it brushes any pollen that may be attached to its head against the stigma ; then in crawling out it can hardly escape getting some more pollen dusted on its head.

In Habenaria and other related orchids the pollen is sticky and united into masses attached to a stalk with a sticky disk at the end. When an insect enters the flower for nectar it will strike against some of the pollen masses and carry them away on its head to another flower. The sticky stigma will pull off some of the pollen grains and pollination takes place.

Pollination of Smyrna Figs.—Figs are dioecious, some trees bearing only figs with staminate flowers, others only figs with pistillate flowers. The process of " Caprification " consists in hanging branches bearing staminate figs in pistillate trees. The fig wasp (Blastophaga grossorum) lives in the staminate fig (caprifig) and deposits her eggs. The new generation of wasps enter another young inflorescence and deposit eggs as before.

When the staminate branches are hung on pistillate trees, the wasps on emerging enter the young pistillate figs, but they are unable to deposit their eggs in the cavity of the ovary. As a consequence no galls are formed, and at the same time pollen has been brought from the staminate figs to the stigmas of the pistillate figs.

Figs that ripen without fertilization do not, of course, set seed, nor do they have the characteristic nutty flavor of the fertilized ones, nor can they be dried for shipping.

Pollination of Legumes. The Leguminosae have a characteristic butterfly-shaped corolla. The ten stamens and the single carpel are encloesd in the boat-shaped " keel " formed by two petals. As a rule the stigma projects a little beyond the anther sacs. The visiting insect naturally alights on the keel, but the weight depresses it, and the stigma first strikes the body of the insect. At the same time some of the pollen is rubbed against the insect's body. When the insect visits another flower the stigma receives some of the pollen.

Pollination of Honeysuckle.—The common honeysuckle has a long two-lipped corolla tube with five long stamens inserted in its tube. The style is longer than the stamens and projects beyond the mouth of the corolla tube. It is visited by hawk-moths. The anthers mature first, and the long style is bent downward out of the way of the moths. After the pollen is shed the withered stamens bend down and the style moves up to a horizontal position. By this device the stigma is pollinated by pollen from another flower.

In the event of wet, cool, or windy weather no moths will appear, but instead the next day bees and flies will pillage the flower for pollen and bring about cross-pollination.

Pollination of the Skunk's Cabbage.—This plant, you will remember, has a spadix enveloped in a purple-mottled fleshy spathe, and is one of the first to make its appearance in spring. W. Hamilton Gibson calls it the " Hermit of the Bog." The spadix is crowded with flowers. In some plants the pistils of the spadix mature before the stamens, consequently cross pollination is easily effected. In other spadices the upper flowers mature their pollen before the stigmas, while the lower flowers mature their stigmas first.

In Jack-in-the-Pulpit the flowers are dioecious. It is pollinated mainly by fungus-gnats.

Pollination of the Canna.—In this flower there is one functional stamen which in the young stage almost envelopes the style. The stigmatic surface, however, is opposite to that next which the anther lies. About the time the flower opens the pollen mass becomes soft and adheres to the style. When a bumble bee alights on the labellum of the perianth its head touches the stigma. Soon, however, the labellum bends and the bee is hurled head foremost against the pollen. As it sips the nectar no pollen is transferred to the stigma. On visiting another flower the pollen on the head of the bee comes first in contact with the stigma.

Pollination of the Mints.—The flowers of the mints have labiate or two-lipped corollas. The thread-like style and forked stigma lie in the arched upper lip. The stamens have peculiar hinged connectives, with only one functional anther sac. The pollen matures before the stigma. When a bee visits a flower he pushes the lower end of the hinged connective and the upper end bearing the anther strikes his back, dusting it with pollen. On visiting an older flower the pollen is brushed against the stigma of the lengthened style, and cross pollination occurs.

Pollination of the Turtlehead (Chelone glabra).—The white flowers have a 2-lipped corolla, nearly closed at the entrance by a swollen palate, and barricaded within with spines. They are effectually visited by worker bumble bees. The stigma projects slightly from beneath the tip of the upper lip of the corolla. The anthers of the stamens stand behind the stigma. The stamens are flattened laterally so that they are readily bent to either side by the visiting bee, upon whose back the anthers shower their pollen. As the bee enters another flower the pollen comes into contact with the overhanging stigma and pollination takes place.

Turtlehead is not only a good example of mutual fitness but also of exclusiveness.

Pollination of the Common Figwort.—These flowers are irregular, urn-shaped, and when they first open the style and stigma protrude, while the four stamens are curved in the tube. The stigma is ripe before the stamens. A little later the stamens straighten and protrude from the tube while the style is in a wilted condition. By this simple means cross-pollination is secured by the visits of insects.

Pollination of the Willow Herb.—When the flower opens the eight stamens stand out quite prominently while the style is curved downward and backward out of the way. A little later the stamens bend away and the style straightens up and the stigma lobes expand. Here again is a simple contrivance for ensuring cross-fertilization.

There are many other flowers that show special adaptations to cross-fertilization by insects, but perhaps a sufficient number of illustrative examples has been given to show the wonderful diversity of these adaptations. Perhaps the plant aspect of the question rather than the insect has been emphasized, but in a simple treatment it could hardly be otherwise. Insects do not show adaptations to the same extent as flowers. Undoubtedly the mouth parts of sucking insects have been greatly modified with reference to flower structure, as for example those of hawkmoths, and butterflies. The mouth parts of Syrphidae, Muscidae and Stratiomyiicae, according to Hermann Muller, are specially adapted for feeding on pollen. Again, the Apidae among the Hymenoptera have specially long tongues so that they are able to lap up the nectar in deep flowers. The bodies and legs of pollen-gathering insects, such as bees and certain flies, are densely hairy, and this feature appears to be an adaptation for it is not observed on species that do not gather pollen. (You are all familiar with the peculiarities of the bumble and honey bees.) Pollen-feeding beetles, according to Folsom, have the mouth parts densely clothed with hairs, as in Euphoria.

If we study the mouth parts of the grasshopper or Harpalus we get a fairly accurate idea of the type of mouth parts that are unspecialized, and which are not found in flower-visiting insects. But few beetles have taken to the flower-visiting habit, and these show more or less alteration of the mouth parts in a narrowing of the front of the head and in the presence of nectar-gathering hairs in place of the usual teeth.

The mouth parts of most nectar-eating insects may be grouped into three types :—

(1) The hinged and retractile type, variously developed in bees and flies.
(2) The coiled type, characteristic of butterflies and moths.
(3) The jointed and rigid type, characteristic of bugs.—(Needham.)

The **honey-bee** is the main agent in the pollination of the apple, pear, blackberry, raspberry, etc.

The **Long-tongued Sphinx Moths** pollinate the honeysuckle, lilac, azalea, tobacco, petunia, thornapple—mostly strong scented and conspicuous nocturnal flowers.

Nocturnal moths pollinate the Evening Primrose and sometimes milkweeds.

Beetles are largely responsible for the pollination of pond lilies, and golden rods.

Butterflies, moths and bees most frequently pollinate lilies and orchids.

I would refer those specially interested in insect pollination and the adaptations of flowers to that end to Knuth's "Handbook of Flower Pollination" in three volumes, where nearly all the available information on this subject has been collected. This large work is published by the Clarendon Press, Oxford.

A less pretentious but a very convenient book is Gibson's "Blossom Hosts and Insect Guests" published by Newson & Co., New York. A valuable supplement gives a list of the chief insect visitors and the methods of fertilization of the common wild flowering plants.

The Evolution of Flower and Insect Adaptations

To some minds there is as much interest attached to the interpretation of the adaptations as to the observation and study of them. Some minds are satisfied with the modus operandi of the delicate processes involved, while others demand, as it were, a picture of the evolution of the adaptations, the factors involved, and how these factors have operated.

Darwin's Theory of Natural Selection furnishes a fairly satisfactory explanation for most of the adaptations, but there are a few difficulties in the way. According to this theory some variations are useful, and some are not useful. Some of these variations are heritable and some are not. A time comes in the life of every species when a struggle for existence arises through excessive multiplication or scarcity of food. Then will take place an elimination of the unfit, that is, those not favored with the possession of useful heritable variations. Natural selection, it will be seen, cannot originate, or account for the origin of useful characters among organisms, but it preserves and accumulates variations that are advantageous, fit and heritable. Natural selection cannot operate, therefore, until useful variations exist, and the question of the origin of variations lies outside the question of Natural Selection as developed by Darwin.

It is a comparatively easy matter to explain by Natural Selection the ordinary adaptations of flowers, but as was stated at the outset, there are cases where the devices do not work perfectly and sometimes even miscarry.

A few years ago it was the habit of the enthusiastic thorough-going followers of Darwin to see in every modification a response to the action of Natural Selection. They drew largely upon their imaginations for conditions that may never have existed. They made the great error of mistaking interpretations for facts, as many persons are very apt to do when they desire to prove a point. There may be other, and perhaps better, explanations of the facts of adaptation which they saw everywhere about them. Grant Allen's works, for example, possess great charm of language, but they are marred to some extent by the mistakes just referred to.

The common blue violet (Viola cucullata), for example, has an elaborate mechanism for cross pollination but it fails to work. This flower has an irregular corolla with a saccate petal spur which holds nectar secreted by the spurs of the two stamens. There is, moreover, a slight perfume. The entrance to the flower is narrow, but sufficient to allow the entrance of the proboscis of a bee. Into the spur run two spurred stamens, so that when the bee sends its proboscis into the spur some of the pollen is dislodged and carried away. The stigma is so arranged that no pollen is lodged on it as the bee withdraws but becomes covered with pollen as the bee enters the flower.

But seldom does a bee visit this flower in spite of all its delicate mechanism, and seldom does this flower set seed, except by its concealed flowers on the ground which are self-fertilized. This looks like a case of over-specialization and cannot be explained by natural selection. By natural selection it is possible to explain adaptations, but not over-adaptations.

DeVries gives another interesting case of a flower with a mechanism for cross-fertilization by insects but all to no purpose on account of the fact that self-fertilization occurs before the buds open. This is the common Evening Primrose (Oenothera biennis). He says " The style is short and the anthers are arranged around the stigma. They (the anthers) open half a day before the petals open and the insects visit the flower. During the last hours within the closed bud fertilization usually takes place, and all is over before the insects come, insuring in this way a most complete self-fertilization. All the bright display of broad and shining petals, of honey, and a sweet fragrance is here absolutely useless and superfluous."—(DeVries Plant Breeding, p. 252—3.)

It is probable that there are many other examples of this kind, where development has exceeded the demands of utility. We may well ask :— What is the use of all the complicated mechanism of the orchids and the milkweeds? Of what use is the scalloping and fringing of the corollas of the mints? Would not the simpler plans of the less specialized flowers suffice? Is it not likely that other processes than Natural Selection are in operation making for the evolution of new forms? Darwin himself was aware of this possibility, for he said : " I am convinced that Natural Selection has been the most important, but not the exclusive, means of modification."

Eimer and Nageli have proposed the theory of **Orthogenesis,** by which they mean that there is a tendency, either innate or directed by the environment, toward some particular line of development. This tendency tends to keep going in a straight line.

DeVries has proposed the **Mutation Theory** where new forms originating per saltum may or may not be favored by Natural Selection in the struggle for existence. In many cases mutations may not be the best adapted to the environment, but may persist for a while. Morgan takes up the well-known cases of the Primrose and Loosestrife which Darwin tried to show were special adaptations to insure cross-fertilization. It will be recalled that dimorphism exists in Primula. Darwin fails to show that there is any advantage in two forms, so that their development by Natural Selection fails. " If, however, these two forms should appear as mutations, and if, as is the case, they do not blend when crossed, but are equally inherited, they would both continue to exist as we find them to-day."—(Morgan, p. 369.)

I have not touched many other interesting phases of the mutual adaptations of insects and plants, such as Galls, " ant plants " of the tropics, and insectivorous plants, but the discussion of these topics would require separate treatment.

Notes

Besides Sprengel and Darwin, mention should be made of Koelreuter, Fritz Müller and Hermann Müller.

Koelreuter was born 1733, took his M.D. degree in 1755. He was the first to make observations on flower pollination and to point out the part played by insects. Published this great work 1761. Died 1806.

Fritz Müller, born 1822, was a type of the modern naturalist, after Darwin's own heart. He went to Brazil in 1852, where he collected and observed indefatigably. He wrote his famous " Facts for Darwin " (Für Darwin) in 1864. Died 1897.

Hermann Müller, brother of Fritz Müller, born 1829 ; published his " Fertilization of Flowers by Insects and their Reciprocal Adaptations " in 1873 ; died 1883.

Darwin's works relating specially to this subject are :—

1. " The Origin of Species by Means of Natural Selection," 1859.
2. " The Effects of Cross and Self Fertilization in the Vegetable Kingdom," 1876.
3. " The Various Contrivances by which Orchids are Fertilized by Insects," 2nd Ed. 1884, 1st Ed. 1862.
4. " Insectivorous Plants," 1875.
5. " The Different Forms of Flowers in Plants of the Same Species," 1877.

PLANTS SHELTERING NOXIOUS INSECTS AND FUNGI

By J. C. Chapais, St. Denis (en bas), P.Q.

SUMMARY:—Plants which co-operate in the dissemination of noxious insects and fungi:—The Choke Cherry Tree, The Barberry Bush, The Mountain Ash, The Red Alder.

Plants that co-operate in the dissemination of noxious insects and Fungi. It is well that the Quebec Society for the Protection of Plants should give information to those of its members who don't know that there are some plants in existence that play the part of propagators of some insects and fungi noxious to our cultivated plants. While speaking here of fungi, I mean the hurtful organisms which cause fungous diseases amongst our useful plants. I wish, to-day, to denounce three of these plants which ought precisely on that account to be considered as enemies of the farmer and the fruit-grower. They are: the Choke Cherry Tree, the Barberry Bush and the Mountain Ash. The Red Alder is also mentioned, but for another reason.

Choke Cherry, **Cerasus Virginiana, Le Cerisier de Virginie, Le Cerisier a grappes.** This cherry tree, very common in the woods of all parts of our province, shelters two great enemies of our orchards. One is the **Forest Tent Caterpillar**—Malacosoma or Clisiocampa disstria—La Chenille à Tente des Bois. Even in the years when we see little of this caterpillar in our orchards, one is sure to see a few groups of them on the Choke Cherry Tree. For instance, in the cemetery of the parish where I live, I have to clean, almost every spring, some of those trees that grow there and show a whole population of those devouring insects. The other enemy of our orchards sheltered by that tree is the **Black Knot**—Plowrightia morbosa—Le Nodule noir du Cerisier—that microscopic fungus that caused so much damage to our trees some thirty years ago, and that has a constant tendency to reappear, particularly on account of the hospitality tendered it by that tree. We, therefore, advise the fruit-growers to let none of those Choke Cherry Trees grow in the neighbourhood of their orchards, or, if they feel inclined to keep some near their dwellings in order to use their fruit which is somewhat attractive to children, to inspect them thoroughly every spring and fall, so as to keep them free from these animal and vegetable parasites.

Barberry Bush—Berberis vulgaris—Vinettier—Epine-Vinette Here is a non-indigenous plant which has been brought from Europe, but which, being well acclimatized here, plays bad tricks with us by giving shelter to a parasite of our gramineous plants that, under the shape of a microscopic fungus named **Puccinia graminis,** Puccinie des Graminées—often causes much damage to our crops of grain. Puccinia belongs to the Uredineae family and is generally called Rust. Rust comes under two forms: the red rust and the black rust. The red one, the Uredo linearis, makes its appearance at the end of the spring, and invades wheat, barley, rye and oat fields under the aspect of orange-tinted spores. After a few weeks these spores seem to take on a deeper tint, due to the formation on the same mycelium of a new form of spores, the teleutospore or black form. These new spores grow on wheat from the same threads as the Uredo forms, and live in the stubble or in the soil during the winter. They germinate in the spring and produce secondary spores which can grow only on the Barberry Bush. The pustules after fifteen or twenty days break through epidermis of the leaves and emit a new form of orange-tinted spores which do not germinate on the Barberry Bush, but invade wheat, barley, rye or oats, as Uredo linearis. It is therefore important to keep no Barberry Bushes growing in the neighbourhood of fields where cereals are grown.

A thing not to be forgotten is that Puccinia graminis is a parasite of gramineous perennial plants, other than cereals, which are annuals, such as Couch-grass and Orchard-grass, and that when it lives on the latter it emits in the spring the orange-tinted spores of Uredo linearis. But it has been observed that these spores acquire a recrudescence of vitality when they come from the Barberry Bush.

Mountain Ash—Sorbus Americana—Cormier—Sorbier d'Amerique. Here is another plant, of the Pomaceae family, the presence of which should be dreaded in the environment of orchards, for it is the favorite refuge of the **Flat-headed Apple-tree Borer**—Chrysobothris femorata—Ver Rongeur à tête plate du Pommier, and of the Striped Round-headed Apple-tree Borer—Saperda candida—Ver Rongeur à tête ronde du Pommier.

When it is known how insidiously the borers penetrate into our apple-trees, it is readily understood that one cannot be too careful in warding them off, and especially in avoiding their favorite lodgings. The fine appearance of the Mountain Ash as an ornamental tree to gladden the fall scenery with its corymbs of bright red fruit, induces us to keep it around our dwellings. Then beware of the borers, if there is an orchard in the vicinity !

Common Alder—Alnus rubra—Aulne Commun—Aulne Rouge. If I mention here the Common Alder, it is not so much to denounce it as a shelterer of some orchard enemies as to reinstate it in the opinion of a few fruit-growers who have denounced it to me as being guilty of giving shelter to the **Woolly Aphis of the Apple**—Schizoneura lanigera—Puceron lanigère—Puceron blanc. I, myself, believed in this imputation till last fall when, travelling along a road through the woods in St. Marguerite parish, Terrebonne County, I really saw for the first time some alder bushes infested with what I believed to be the Wooly Aphis of the Apple. As for a long time I have made a point of identifying as well as I can the comparatively new insects that I find, I brought with me a branch of these infested alders and thus became able to make sure that I was looking not upon the Wooly Aphis of the Apple, but upon the **Pemphigus Alni**—Pemphige de l'Aulne—genus of the Aphididae family but quite different from the Wooly Aphis. Referring to Provancher, I read that these insects are found on the Alder, towards the end of September, especially in damp localities, and that they usually form compact clusters of many inches in extent. This compares exactly with what I saw on the alders that I inspected on October 27th last, in the woods of St. Marguerite.

REPORT ON PROGRESS MADE ON THE LIST OF INSECTS OF THE PROVINCE OF QUEBEC

At the last annual meeting our President referred, at some length, to a proposal that this Society undertake to compile and publish a "List of the Insects of the Province of Quebec." The suggestion seemed to meet with the unanimous and hearty approval of everyone present; so that we need not refer to its earliest stages, further than to state that the compilation of the list was left in the hands of a committee consisting of Prof. Swaine, Mr. Chagnon and Mr. Winn.

The committee met at Macdonald College on March 25th and went carefully into the various forms in which a list or catalogue could be issued and it was decided that we could not do better than follow, as closely as possible, Prof. J. B. Smith's Insects of the State of New Jersey. So valuable has this list proved that, in spite of the fact that we selected the model a year ago as being ideal, the State of New Jersey decided to again revise it and bring it up to date. Within the last few months this new edition has appeared, and we hear the demand for it is so great that it is already difficult to obtain copies.

Briefly, therefore, your committee decided as follows: That the list be 6 x 9 inches in size (demy 8vo) probably about 500 or 600 pages., a few copies bound in cloth, balance in paper.

Illustrations in the text, of injurious insects from electrotypes obtainable and perhaps a few full page plates, typical of the various orders of insects between each division of the work, selecting well-known species and those of economic importance.

It was the opinion of the committee that the publication be sent out free and that probably 1000 copies would be needed.

The work to consist of two parts. I, On Insects: the Injuries they cause and how to control them; II, List of the Insects of the Province. In the first part would be chapters devoted to Introductory Remarks, Development and Classification; Relation of Insect to Man; The Control of Injurious Insects; Spraying Methods; with a Map of the Province and cuts of the latest spraying machinery.

In part II, the various orders to be listed as completely as possible, from published records, from personal observations and studies, from the various collections throughout the province, and by a special effort to study up some of the more neglected orders. Notes to be given of the recorded localities, the months of appearance, their larval food plants and other information.

At the back of the book would be a short description of the localities mentioned, an explanation of abbreviations of collectors' names, a note of acknowledgment of assistance, loan of electrotypes, specimens, etc., and an Index.

Well, gentlemen, you will think your committee has some big ideas regarding this list. We have, and we have also a big field of some 351,000 square miles whose varied insect fauna has been studied only by a small, a very small, number of naturalists, mostly in spare hours or moments, snatched here and there out of a busy life devoted to other pursuits of a more commercial nature. No attempt has hitherto been made to collect and publish a list of the insects of all orders, so it will be inevitable that our first edition will be far from complete, but will at least serve as a basis for future records.

In order to secure uniformity in making records it was decided to use card index slips 3 x 5 inches, one for every species met with; to indicate only the months of occurrence and that by Roman Numerals; and to abbreviate the names of those whose records are quoted.

In dividing up the work on the different orders it was arranged that the Coleoptera be handled by Prof. Swaine and Mr. Chagnon; The Lepidoptera by Mr. Winn; The Hemiptera by Mr. Moore; The Coccids by Mr. Brittain; The Diptera by Mr. Chagnon. The remaining orders were left with Mr. Winn to collect records as far as possible from published lists, and have them corrected and revised by such authorities as Mr. W. Hague Harrington, of Ottawa, in the Hymenoptera; and Dr. E. M. Walker, of Toronto, in the Orthoptera, Odonata and the Neuropterous orders, if their assistance could be obtained.

The work of making out the cards has proceeded very satisfactorily and about 5000 species have been listed so far, including in most cases a good many notes on distribution. Local lists of captures in any order are greatly desired and the committee will gladly undertake to name any specimens that may be sent in to Macdonald College from any part of the Province for the privilege of recording the localities. The committee were fortunate in having the assistance of our friend the Rev. Dr. Fyles, who furnished a complete list of the insects in his collections of all orders made in various parts of Quebec. The material in most of the private collections in Montreal has been looked over and noted, and many records have been received through the kindness of Mr. Arthur Gibson, Chief Asst. Entomologist of the Dominion Experimental Farms, Ottawa, of insects sent in for determination.

A considerable amount of time has been spent in going through files of such publications as The Canadian Entomologist, The Annual Report of the Entomologist Society of Ontario; The Ottawa Naturalist; The Proceedings of the Royal Society of Canada; The Geological Survey Reports; Le Naturaliste Canadien; The Record of Science; The Canadian Naturalist. Notes have been made of all local lists and reference to insects met with, but not all have been as yet transferred to their respective cards. Any information about the existence of lists or collections of insects that may have been overlooked by us will be of the greatest value to the committee.

A difficulty that has confronted us, and a most vexatious one, is the fact that in most of the older collections now in various museums, the specimens are almost wholly without locality labels—the last generation had a horror of labels! In a collection of insects, while the owner is alive, he usually has a fairly accurate knowlegde of his specimens' haunts and habits; but after the owner has passed away, a specimen without a label has just a little less value than the label and pin without a specimen. These collections in the present list have to be totally ignored, greatly to our regret, but we hope in most cases to be able to include some of their captures from published records. A good many published lists contain specific names followed by a note of interrogation. These also will be omitted.

We trust that the foregoing report will meet with your approval and hope at our next annual gathering to be able to hand over the manuscript for publication, if deemed worthy.

Respectfully submitted on behalf of the Committee,

A. F. WINN.

FUNGOUS DISEASES IN QUEBEC IN 1910.

W. Lochhead, Macdonald College.

The growing season of 1910 was abnormal in many regards. Spring opened early in March, but in April cold conditions prevailed for nearly a month. The net result was delayed seeding and harvest in many localities. Moreover, much rain fell in July so that the grass of the fields and lawns remained quite green throughout the season.

Such abnormal conditions are always favourable to the development of fungi. First of all, many plants are attacked by fungi during their early seedling stages. If the plants secure the best possible conditions for healthy growth they are not so readily infected, or much injured after infection. But if the plants become succulent on account of too much moisture, or if, on the other hand, they become dwarfed, starved and ill-fed on account of improper surroundings, in either case they are unable to withstand to any extent the attacks of fungi both from within and without.

Again, abundance of moisture during the growing season favors the chances of successful infection of plants by spores of fungi.

On account, therefore, of the abnormal conditions the crops of 1910 suffered more than usually from the attacks of fungi.

Following is a list of the most common fungous diseases observed in 1910 :—

Diseases of Vegetables

Anthracnose of Bean (Colletotrichum Lindemuthianum) was common but not injurious; more attention should be given to the selection of seed from pods free from disease.

Black Spot of Tomatoes (Macrosporium Solani) was frequently reported as doing damage.

Club Root of Cabbage and Turnips (Plasmodiophora brassicae) was more common than was at first supposed, especially in the truck gardens about Montreal.

Downy Mildew of Cucumbers (Peronoplasmopara Cubensis) was not injurious.

Downy Mildew of Lettuce (Bremia lactucae) was not abundant.

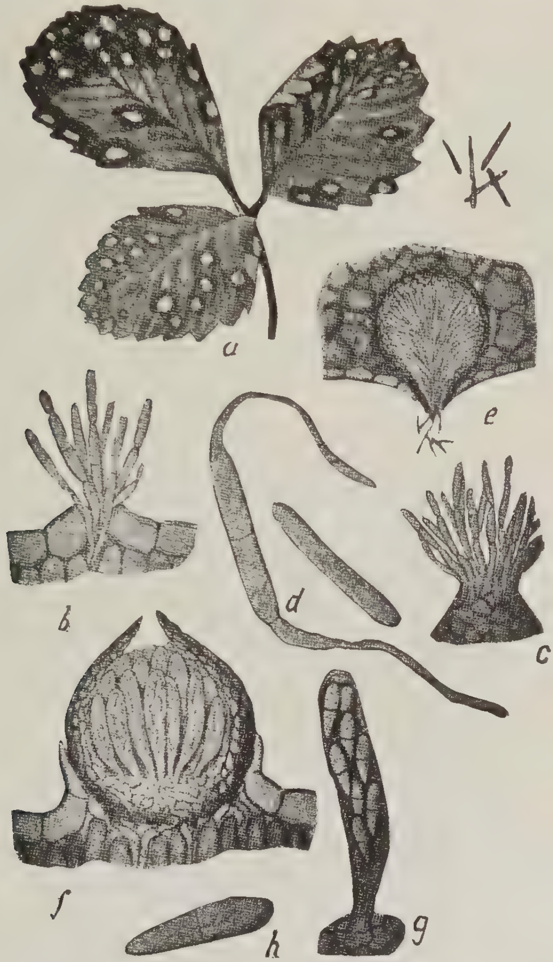
Drop of Lettuce (Sclerotinia libertiana) was often reported from greenhouses.

Dry Rot of Potatoes (Fusarium Oxysporum) was injurious on stored tubers.

Early Blight of Potatoes (Macrosporium Solani) was prevalent but not injurious.

Late Blight of Potatoes (Phytophthora infestans) was not injurious.

Leaf Spot of Beets (Cercospora beticola) was common but not injurious.



a, A leaf of strawberry affected with leaf blight; **b,** spore bearing tuft of mycelium bursting through the epidermis of the leaf; **c,** summer spores arising from apex of a resting spore case; **d,** summer spores (conidia), one germinating; **e,** section of a spore pustule (spermogonium) produced in summer; **f,** section of resting or winter spore case (perithecium) found in tissues of old diseased leaves which have lain in the ground over winter; **g,** a spore sac (ascus) containing eight two-celled winter spores; **h,** a winter spore (ascospore) very highly magnified. (After Longyear.)

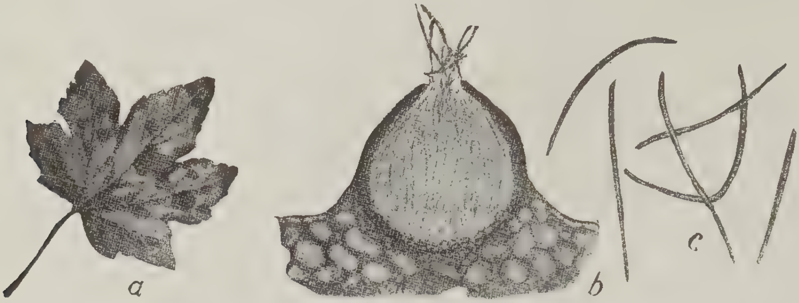
Leaf Spot of Celery (Cercospora apii) was common but not injurious.

Leaf Spot of Strawberries (Mycosphaerella fragariae) was prevalent but not injurious.

Rhizoctonia of Potatoes (Rhizoctonia sp.) was abundant.

Scab of Potatoes (Oospora scabies) was abundant and did much injury.

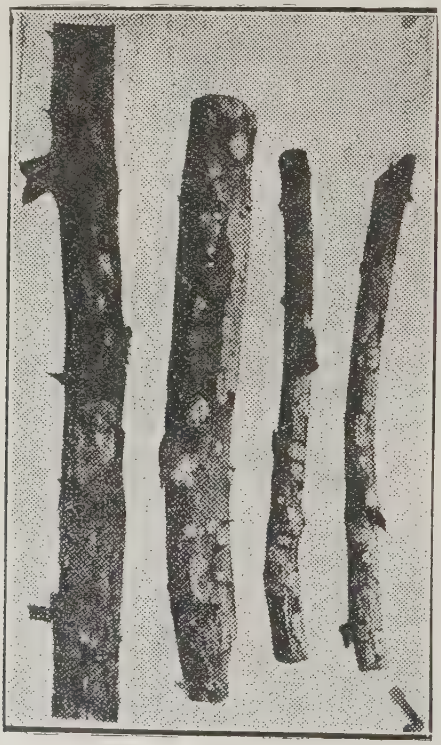
White Rust of Salsify (Albugo tragopogonis) was common but not injurious.



a, Leaf of currant affected with the Leaf Spot disease; **b**, a spore-producing pustule magnified, from a diseased spot of a leaf, giving out long, slender spores, a few of which are shown highly magnified at **c**.—(After Longyear.)

Diseases of Small Fruits

Anthracnose of Blackberry, etc., (Gloeosporium venetum) was prevalent but so far as could be ascertained not injurious.



Canes of Raspberry showing spots produced by Anthracnose.

Anthracnose of Currant, etc., (Pseudopeziza ribis) was prevalent but not injurious.

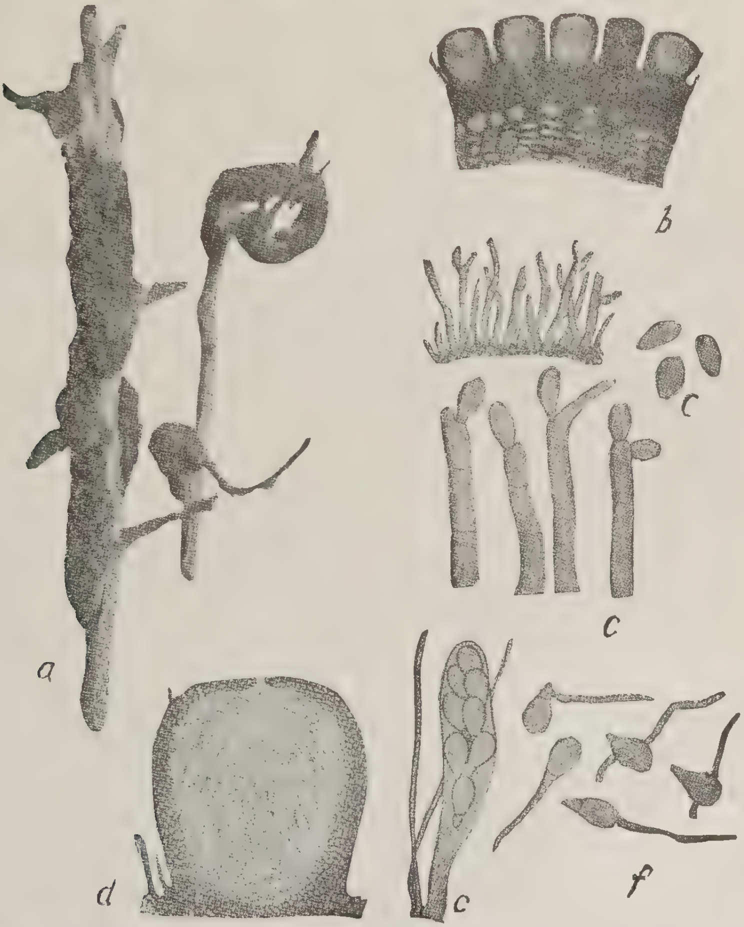
Downy Mildew of Grape (Plasmopara viticola) was common and did considerable injury.

Leaf Spot of Raspberry (Septoria rubi) was quite prevalent but did little injury.

Orange Rust of Raspberry (Gymnoconia interstitialis) was common and did some damage.

Powdery Mildew of Gooseberry (Sphaerotheca mors-uvae) was very destructive to English varieties.

Powdery Mildew of Grape (Uncinula necator) was scarce.



Black Knot fungus: **a**, mature knots on plum branches; **b**, magnified section of a knot showing the spore cases (perithecia); **c**, spore stalks (conidiophores) which grow on the surface of the knots when young and give rise to summer spores (conidia), **c**; **d**, section of a winter spore case (perithecium) more highly magnified, showing numerous contained spore sacs (asci), one of which is shown very highly magnified at **e**; **f**, several of the two-celled winter spores germinating in water. (After Longyear.)

Diseases of Plum and Cherry

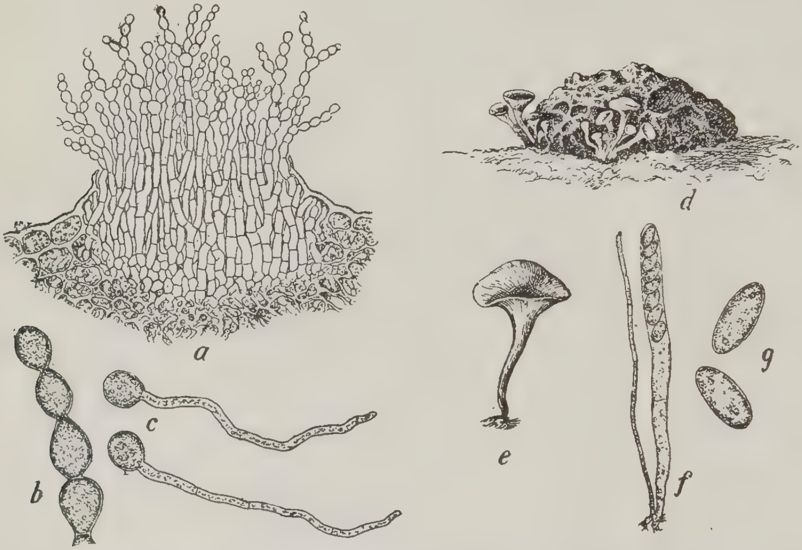
Black Knot (Plowrightia morbosa) was common throughout the province.

Brown Rot (Sclerotinia fructigena) was more or less prevalent.

Plum-Pockets (Exoascus pruni) was quite severe in some localities.

Powdery Mildew of plum and cherry (Podosphaera oxyacanthae) was observed once or twice but is not injurious.

Shot-Hole (Cylindrosporium padi) was more or less prevalent but not seriously injurious.



Brown Rot of Plums: **a**, Section through a diseased plum showing a spore pustule bursting through the skin of fruit and producing chains of spores (conidia); **b**, part of a spore-chain; **c**, spores germinating in a drop of water (all highly magnified); **d**, an old mummy plum which has lain on the ground over winter giving rise to small fleshy outgrowths (ascophores) in form like little wine glasses; **e**, one of these outgrowths somewhat enlarged; **f**, some of the slender spore sacs (asci) which line the cup-like part of the fleshy organs shown at **d, e**; **g**, mature spores from a spore sac, highly magnified. (After Longyear).

Diseases of Apple

Black Heart of Apple, supposed by many to be due to winter killing, by others to a fungus of the nature of Stereum, was frequently observed.

Black Rot of Apples (Sphaeropsis malorum) was not often reported, probably because orchardists are not as yet familiar with its appearance as a canker.

Blight (Bacillus amylovorus) was locally quite injurious.

Brown Spot of Baldwins, probably a physiological trouble.

Crown Gall (Pseudomonas tumefaciens) was sometimes found in apple nursery stock.

Fly-Speck Fungus of Apple. (Leptothyrium pomi) was observed quite frequently.

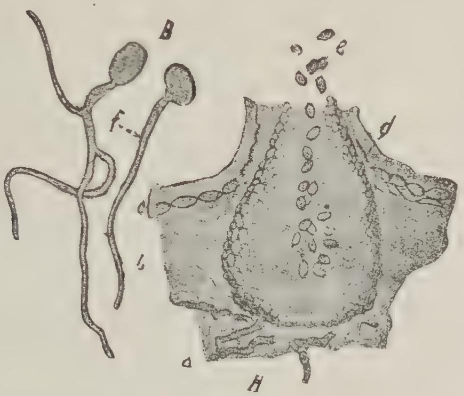
Leaf Spots (spp.) were prevalent but not injurious.

Powdery Mildew of Apple (Sphaerotheca mali) occurred on seedlings in nurseries at La Trappe.

Scab (Venturia pomi) was quite prevalent, especially on Fameuse apples.

Sooty Fungus of Apples (Phyllachora pomigena) was often found along with the Fly-Speck Fungus.

Water Core of Apples, probably a physiological trouble, was found on certain varieties.



Microscopic structure of the Black Rot fungus–: **a**, Section from a wintered specimen of crab apple showing, **a**, the dark-colored mycelial threads among the cells of the fruit, **b**; **d**, a thick-walled spore case (pycnidium), which has pushed through the epidermis, **c**, and is giving off dark-colored spores, **e**, through the protruding mouth; **b**, mature spores germinating in water and giving rise to germ tubes, **f**. All highly magnified. (After Longyear).

Diseases of Cereals and Forage Crops

Black Leaf-Spot of Clover (Phyllachora trifolii) was abundant but not injurious.

Covered Smut of Barley (Ustilago levis) was not injurious.

Ergot of Rye and Grasses (Claviceps purpurea) was frequently observed.

Leaf-Spot of Alfalfa and Clover (Pseudopeziza Medicaginis) was quite abundant and injurious.

Loose Smut of Barley (Ustilago nuda) was prevalent in some districts.

Loose Smut of Oats (Ustilago Avenae) was abundant and did much damage.

Loose Smut of Wheat (Ustilago Tritici) was not seriously injurious.

Orange Leaf Rust of Cereals (Puccinia glumarum) was quite abundant on the leaves.

Powdery Mildew of Wheat (Erysiphe Graminis) was not severe in 1910.

Rust of Clover (Uromyces trifolii) was common but not seriously injurious.

Rust of Corn (Puccinia maidis) was common.

Smut of Corn (Ustilago maidis) was common.

Smut of Millet (Ustilago Crameri) was present in some localities.

Stinking Smut of Wheat (Tilletia tritici) was not injurious.

Diseases of Ornamentals

Powdery Mildew of Golden Glow (Erysiphe cichoracearum) was prevalent in late summer and autumn, especially in the conidial form.

Powdery Mildew of Willow (Uncinula Salicis) was very abundant in some localities.

Powdery Mildew of Lilac (Microsphaera Alni) was common as usual in autumn.

Powdery Mildew of Roses (Sphaerotheca pannosa) frequently observed.

Rust of Asters (Coleosporium Sonchi) common but not injurious.

Rust of Carnations (Uromyces caryophyllinus) was common and required care to prevent it becoming destructive.

Rust of Hollyhocks (Puccinia Malvacearum) was quite abundant and injurious.

Rust of Rose (Phragmidium subcorticium and P. speciosum) were both observed.

Rust of Sunflower (Puccinia Helianthi) was common.

SOME FUNGOUS DISEASES OF FIELD CROPS

W. Lochhead, Macdonald College.

The damage done by fungi to standing field crops every year is enormous. Dr. Galloway, Chief of the Bureau of Plant Industry, Washington, estimated the loss in 1898 from wheat rust in the United States at $67,000,000, and Orton of the same bureau estimated the annual loss in the United States from oat smut at $6,500,000, from loose smut of wheat at $3,000,000, from wheat bunt or stinking smut at $11,000,000, and from potato blight at $36,000,000.

Besides the diseases mentioned above are barley smuts, corn smut, clover rust, clover and alfalfa leaf-spots, the powdery mildew of cereals (Erysiphe Graminis) and many others, all of which produce considerable loss.

This article will deal with the most destructive diseases such as the common smuts and rusts of wheat, oats and barley.

Loose Smut of Oats

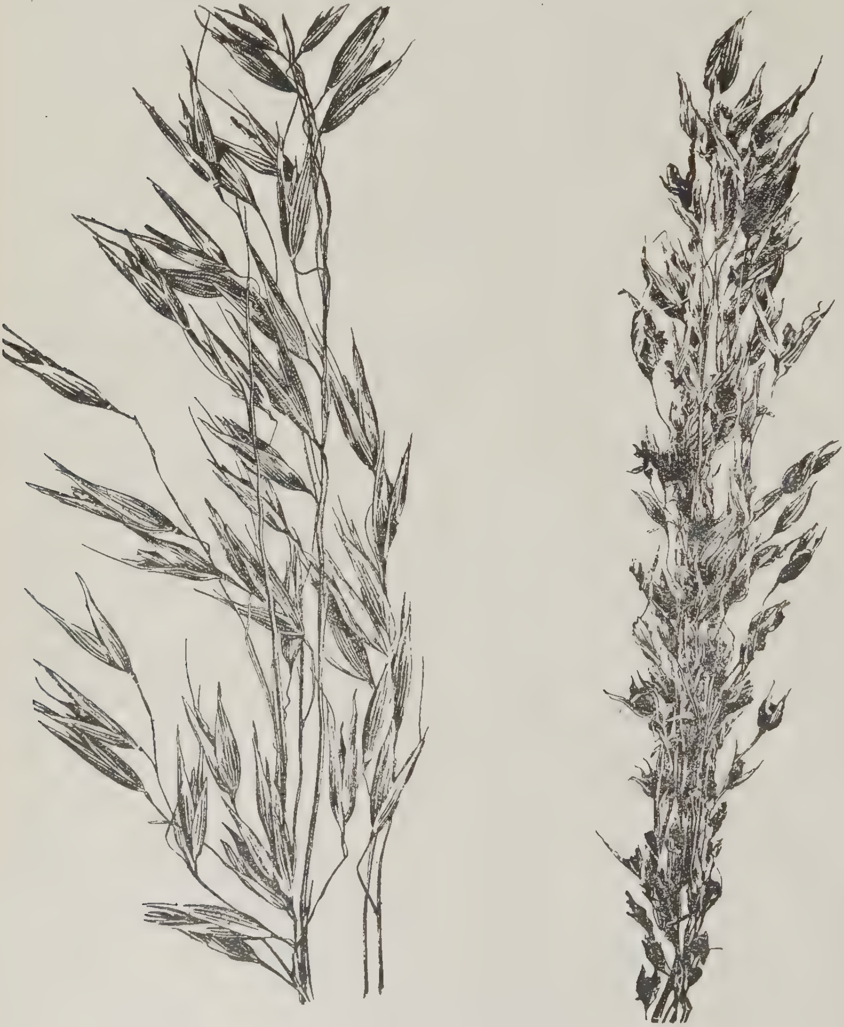
Ustilago Avenae (Pers.) Jens.

This fungus is present in almost every oat field and is one of the most destructive diseases of Cereal Crops. Duggar states the average loss to the oat crop in the United States has been estimated at about 8 per cent. In Quebec the average loss would be somewhat higher.

The appearance of smutted oat plants is quite characteristic. Not only the grain but the chaff of all the spikelets of a head is replaced by the powdery black mass of smut spores which fall away by the action of wind and rain, and leave only the naked branches of the panicle.

Life History. The smut spore attached to the seed oat when sown germinates, and produces a short 4-celled thread (promycelium or basidium). Small spores are produced on the sides and ends of this thread. These germinate and develop a thread which infects the seedling plant. Brefeld showed that oat plants are immune after the leaves have protruded half an inch beyond the leaf sheath. Once within, the fungus thread branches freely and grows between the cells of the host plant from which it draws its nourishment. The threads keep pace with the growing plant and disappear in the older tissues. When the spikelets form the fungus enters the flowers, where it feeds upon the nutriment sent to the ovaries, so that the grains within their enclosing glumes are converted at maturity into black masses of spores.

Treatment. The discovery that only very young seedling plants become infected naturally suggested the method of seed treatment for the prevention of smut. It became clear that if the seed oats were absolutely free from spores of smut no infection could take place, and no smut heads would appear in the harvest.



Oat Smut: On left, a healthy head of oats; on right, a smutted head. (After Freeman.)

Of the numerous treatments that have been tested, three now stand out prominently, viz.:—

(a) **Bluestone,** first tried as far back as 1789.

(b) **Formaldehyde Solution,** first tried as a preventive of oat smut in 1895 ; and

(c) **Hot water,** first reported by Jensen in 1887.

For those smuts, like the loose smut of oats, bunt, loose smut of barley and millet, the formaldehyde treatment is most commonly used. The method of treating is as follows :—Spread the seed oats on a clean floor or canvas, or in a tight wagon box. Sprinkle the oats with a solution of formaldehyde (1 lb. to 40 gallons water), at the same time shovelling them over thoroughly so that every grain becomes thoroughly moistened. It is usual to have one person shovelling and another sprinkling. A gallon of solution should be sufficient for a bushel of oats.

When the oats are thoroughly and evenly moistened cover the pile with a clean canvas and leave covered for two hours. Then uncover, and spread the oats out to dry by shovelling. When dry the oats are ready to sow. Ordinarily it is most convenient to treat the oats the afternoon or evening before they are to be sown, then in the morning they are ready.

Loose Smut of Wheat

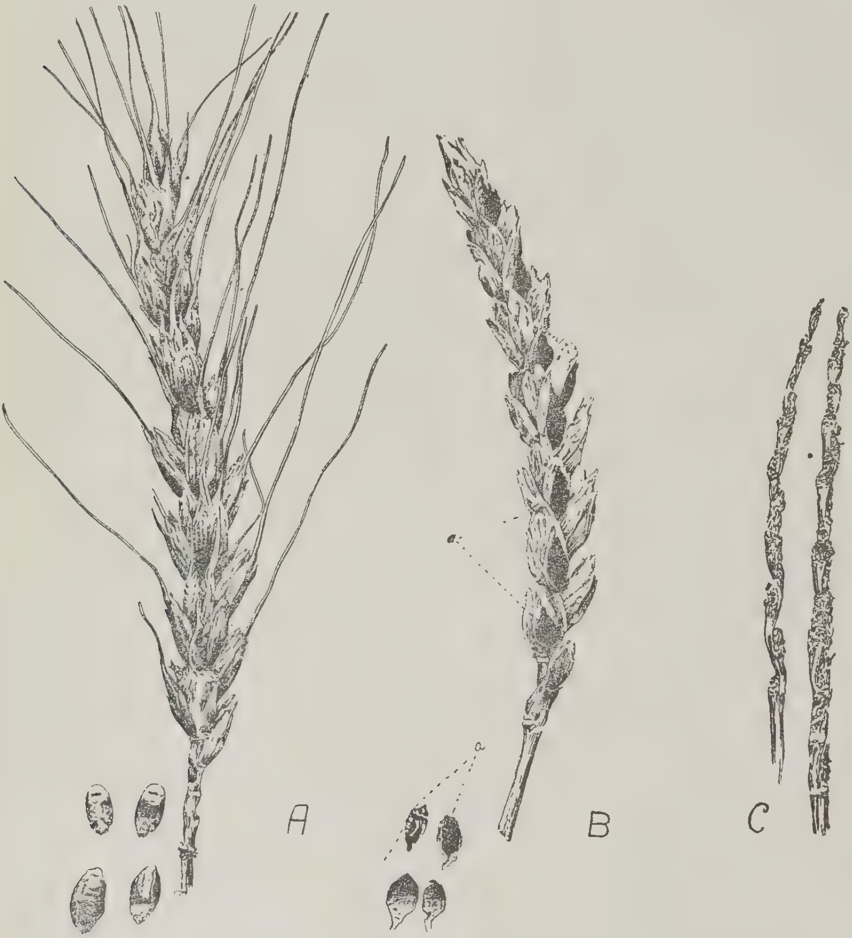
Ustilago Tritici (Pers.) Jens.

This species of smut resembles very closely the loose smut of oats both in the form and germination of the spores and in the effect upon the plant.

The affected wheat plants are rendered practically worthless, the grain as well as the chaff being destroyed by the smut. The black smut masses are set free before harvest as infected plants mature more rapidly than unaffected ones, and by harvest time the heads are reduced to mere stalks.

Experience showed that treatment of the seed with bluestone or formaldehyde was not effective, as is the case with oat smut. Studies by Maddox of Tasmania in 1896, Brefeld in Germany, and others, revealed the fact that infection occurs exclusively at blossoming time. The spores are blown from neighboring infected plants to the spikelets of the head at flowering time. The infection threads enter the ovary by way of the stigma and style where it lies dormant in the ripe grain until the grain is sown and begins to sprout. The fungus then grows up within the plant and produces the characteristic smut heads.

Treatment. Jensen's Hot Water treatment has been found fairly effective in preventing the development of this smut from infected seed. The seed is soaked for over five hours in cold water, then "placed in small loose sacks or wire baskets, and drained for a short time. The sacks or baskets are plunged first for a minute into a tub of warm water at a temperature ranging from 110° to 120° F., then for ten minutes into another tub of hot water kept at 129° F. Temperatures below 124° F. are ineffective, and under no circumstances should a temperature of more than 131° F. be allowed."



Loose and Stinking Smuts of Wheat: **a,** Normal head of wheat, showing kernels below; **b,** head of wheat, affected by Stinking Smut, showing smut balls at **a; c,** Loose Smut. (After Freeman.)

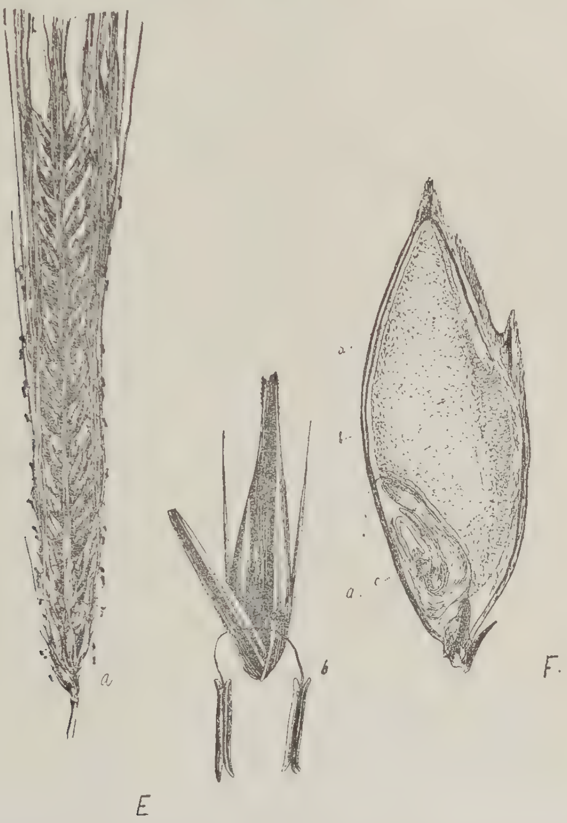
By this method two men can treat one bushel of grain an hour. The seed is dried by spreading it in thin layers on a clean canvas or clean floor.

It should be the effort of every wheat grower to use uninfected seed secured from a field in which there is no loose smut.

Stinking Smut of Wheat or Bunt

Tilletia foetens (B. & C.) Trel.
Tilletia tritici (Bjerk) Wint.

Bunt does considerable injury to the wheat of the West, and to flour made from wheat containing the spores. From the nature of the infection it is evident that every stalk of a diseased plant is affected. It is commonly observed, however, that not every head of a diseased plant carries smut balls. Dr. Faull (Bulletin S. 3, 1907, Seed Branch, Dominion of Canada Department of Agriculture) cites three cases from the wheat fields of the West. At Indian Head, smutted heads were gathered and carefully threshed by hand, and out of a yield of 1,638 grains there were 1,444 smut balls or



F, Longi-section through a Barley kernel, showing the young embryo plantlet at **a**, its growing point at **c**; food for the young plantlet at **d**; seed coat shown at **b**. The smut threads live in the young plantlet (**a**) during the winter, and get into the growing point (**c**) while it is still inside the seed. (For detail of threads in growing point see Fig. 8). Compare with Fig. 6, noting difference in the stage at which infection takes place. (After Freeman.)

88.12 per cent, and 194 " sound " grains (viable). Near Pincher Creek, in Southern Alberta, 11,607 grains were harvested from a collection of diseased plants of which 2,191, or 18.88 per cent were apparently sound. At Creelman, Sask., 54 diseased plants bore 146 heads. Of these heads 88 or 60.27 per cent bore nothing but smut balls, 16 or 10.52 per cent nothing but sound grains, and 42 or 28.77 per cent both smut balls and " sound " grains. That is, of the smutted heads, nearly one-third contained " sound " grains.

This smut attacks only the ovaries and converts the contents into a mass of spores which remain enclosed within the coat. Such masses of confined spores are often called smut balls.

When the spores of smut balls of bunt are moistened, stored in the bin, or mingled with flour, a penetrating disagreeable odour of stinking fish is readily perceived, which detracts from the market value of the grain.

Life History. The method of infection is very similar to that of the loose smut of oats. The spores adherent to the seed grains are the sources of infection. Each spore produces a short one-celled thread (promycelium or basidium) which bears long, often H-shaped, secondary spores. These secondary spores send out infection tubes which are capable of entering the seedling wheat plant up to the time when the first leaf shows itself above the ground.

Faull states that bunt spores are known to retain life in the granary for at least seven years, and in the soil for two years.

There are usually two species of Stinking Smut present viz.: T. foetens and T. Tritici. The former has smooth spores and the latter spiny or reticulate.

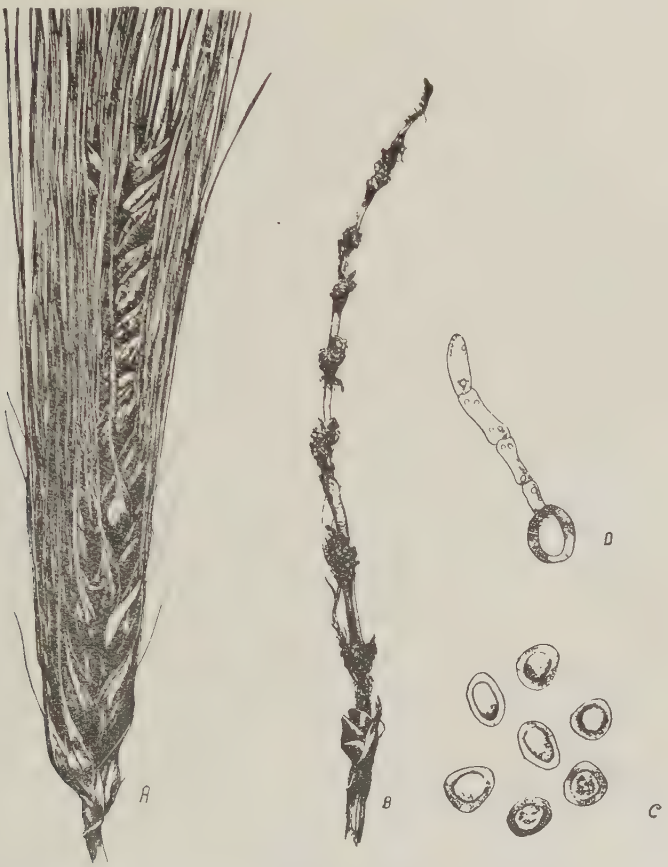
Treatment. The formaldehyde treatment such as recommended for the Loose Smut of Oats is quite effective. Blue stone solution (1 lb. to 20 gallons of water) is often used. The seed grain may be either immersed or sprinkled. If immersed, the grain should be left for 12 hours.

Loose Smut of Barley

Ustilago nuda (Jens.) Kell. & Sw.

Ordinarily this smut does not appear to do injury to Barley, but close observations show that the losses are greater than usually estimated.

Affected plants show that all the spikelets of the smutted heads are destroyed, both grain and chaff. At harvest time the heads are reduced to mere threads and the smut masses are blown away. Smutted plants head earlier than sound plants, the smut showing itself abundant about the regular flowering time. As a rule, too, plants bearing smutted heads are more erect and are taller than unaffected plants, thus furnishing excellent facilities for the distribution of the spores by wind.



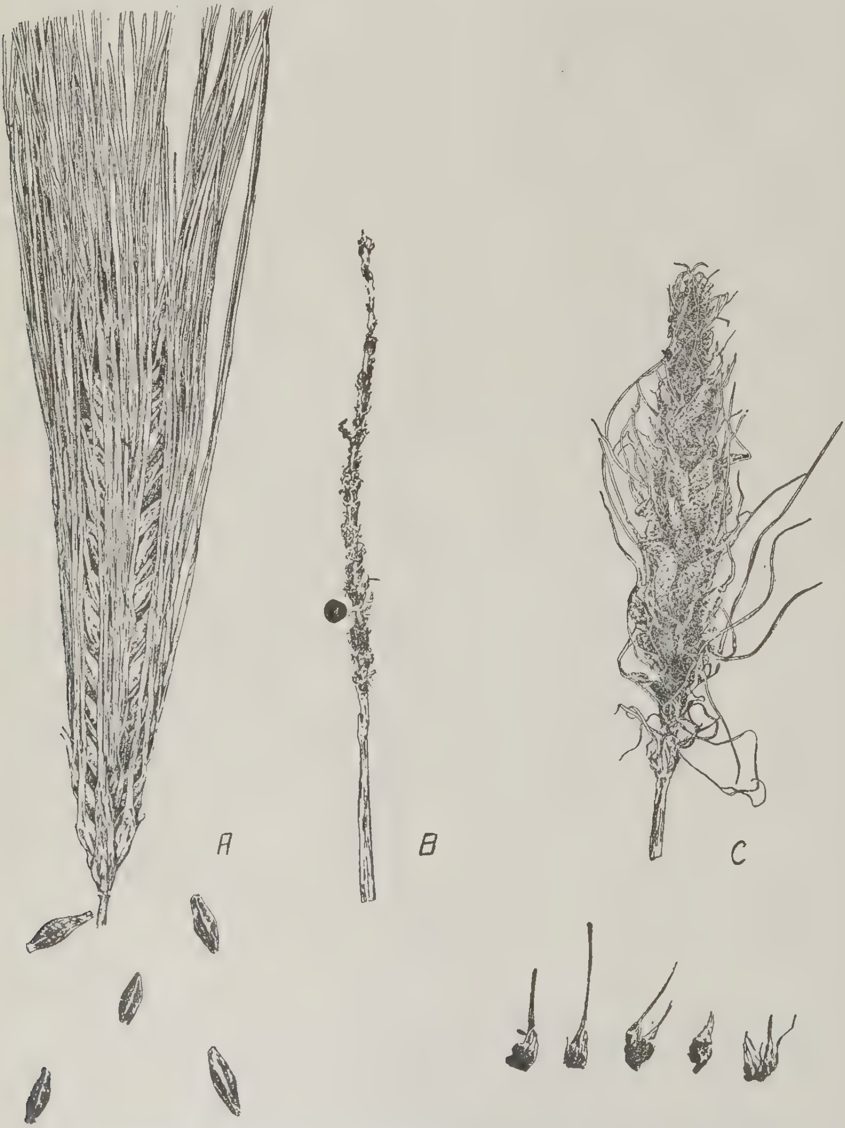
Loose Smut of Barley: **a**, Normal head of barley; **b**, smutted head of barley; **c**, smut spores, greatly enlarged; **d**, spore germinating, greatly enlarged; **e**, (**a**) head of barley, showing open glumes at the stage when the smut spores are probably blown in; (**b**), a single flower. (After Freeman.)

Infection occurs at blossoming time by spores borne to the stigma of the flowers. The fungus remains dormant in the ripe seed until it is sown and germination begins. This method of infection is therefore similar to that of the Loose Smut of Wheat, and the same treatment, viz.: Jensen's Hot Water treatment, is recommended.

Covered Smut of Barley

Ustilago Hordei Jens.

Unlike the loose smut of barley the covered smut retains its mass of spores within the wall of the grain until harvest. The smutted heads also remain enclosed by the upper leaf sheath.



Loose and Covered Smuts of Barley: **a**, Normal head and kernels; **b**, head deformed by Loose Smut; **c**, Covered Smut, showing the smut-balls below. (After Freeman.)

The manner of infection has not been definitely determined. Some investigators believe that infection occurs as in oat smut and wheat bunt, while others maintain that infection takes place later, even at flowering time. The spores of covered smut are smoother than those of the loose smut and their promycelia give rise to secondary spores which are absent in the case of loose smut of barley.

Corn Smut

Ustilago Zeae (Beckm). Ung.

This disease is well known to every corn grower on account of the large and conspicuous mal-formations or growths that are produced on the plant. The disease may attack any part of the plant at any stage of its life, the leaves, stalks, ears, tassels, provided they are still in the young growing condition. The first symptom of the smut on the corn plant is the appearance of a swelling covered with a white membrane. In a short time the swelling becomes black, due to the formation of ripe spores. With the bursting of the membrane the black, dry, powdery mass of spores is exposed to wind and weather. Since it has been shown that the fungus is not conveyed to the new crop in the seed, seed treatment is of little value for its prevention. Moreover, it has been clearly demonstrated that infection is produced by the spores which fall upon any tender growing point. The infection of the ear occurs chiefly by way of the silks in which usually many spores become entangled. The sheaths of the leaves also furnish suitable conditions inasmuch as they hold water and enclose the tender growing part of the stem.

Treatment. The only practical method of dealing with the corn smut is to cut out and burn all the developing smut masses that can be seen on the crop during the growing season ; by doing so the spores are prevented from spreading the disease.

The Rusts of Wheat and other Cereals

The disease called rust of wheat, oats and barley is in reality caused by two or more species of rust fungi, of which **Puccinia graminis** Pers. and **Puccinia glumarum** Schm. are the most common. The former is usually called the **black stem rust** on account of the formation of abundance of black rust on the stems in late summer and autumn, and the latter the **orange leaf rust** on account of the prevailing abundance of orange rust-spots on the leaves during the summer.

Life History. These rusts exhibit three distinct stages : The **cluster-cup** stage in the spring on the leaves of barberry in the case of P. Graminis : 2, the **uredo** stage in summer on the leaves of wheat, barley and oats : and

3, the **teleuto** stage in the late summer and autumn. The cluster-cups occur in yellow clusters on the under surface of barberry leaves. They are sunk in the tissues of the leaf and at maturity show protruding rims. They are filled with chains of orange-red spores (aecidio-spores) which are carried by the wind to the leaves of growing cereals. They serve, therefore, to multiply and spread the disease in the early part of the season.

After infection of the leaves by the aecidiospores there develops within the tissues a mycelium which soon produces pustules of uredospores. By the rupture of the skin of the leaf the uredospores are seen as minute yellowish bodies. These are carried by the wind to other leaves which in turn become infected and produce uredospores. They serve, therefore, to multiply and spread the disease during the growing season.

From the same mycelium which develops the uredo stage arise in late summer lines of dark pustules of teleutospores. Often these develop along with the uredospores in the same pustule. These spores are thick-walled and two-celled, and serve as resting spores during the long winter period.

In spring these teleutospores germinate on the ground or on the stubble and produce short 4-celled threads, each cell producing a secondary spore (sporidium). These sporidia when carried to the leaves of barberry develop infection tubes which enter the leaves and develop a mycelium. From this mycelium arise the cluster-cups already referred to.

Although all these stages enter into the life cycle of wheat rust, observations reveal the fact that they are not all absolutely essential to its propogation. It is known, for example, that wheat rust is rampant in many districts. where the cluster-cup stage is not known. Moreover, in those warmer regions where the host plant remains alive over winter the fungus may continue to produce uredospores all winter. Freeman says, " It is not impossible that these spores from southern states can rapidly work their way north in the early spring and commence the infection each spring. The rapidity of formation of successive crops of summer spores (uredospores) would make this manner of spreading easily possible." Even in cold districts the uredospores have been known to live over winter and start infection in the spring.

Coulter states that, " It is also found that the basidiospores (sporidia) may germinate upon very young wheat plants and infect them."

Eriksson of Sweden is of the opinion that " the rust fungus is transmitted from the rusted parent to the grain as a plasm, which lives a latent life in the cells of the embryo and young plant until just before the eruption of rust spots, at which time it develops an ordinary plant body or mycelium."

Dr. Butler, of India, has " strong reason to believe that the rust cannot arise from spores from the previous crop, nor to any great extent from other grasses affected with the same rusts. A hereditary origin is possible through the use of infected seed, but is not proved as far as India is concerned."

Eriksson's investigations, however, on rusts have yielded some very interesting results on the susceptibility of cereals and grasses to rust. He has shown quite conclusively that the red rust spores (uredospores) on wheat cannot reproduce the disease on oats, nor can those on oats reproduce the disease on wheat or barley, nor those on barley reproduce the disease on wheat and oats, although all these forms belong to one species, Puccinia Graminis. Thus there are several distinct " biological varieties."

Variety 1.—P. Graminis tritici, on wheat, Hordeum.

Variety 2.—P. Graminis Secalis, on rye, barley, couch grass, Elymus and Bromus.

Variety 3.—P. Graminis avenae, on oats, meadow foxtail and Cocksfoot.

More than a dozen such " varieties " are now recognized.

In other words, this rust adapts itself so closely to its various plants that it develops " varieties " which develop on certain plants but refuse to develop on other species of the same genus or host. Some species and varieties of grasses are, therefore, immune from some forms of black stem rust.

Treatment. No treatment has, as yet, been devised for the prevention of rust on cereals. The eradication of barberry bushes has not brought relief, and the spraying of large fields is entirely out of the question. A partial solution of the difficulty appears to be possible by the planting of varieties of cereals that are rust-resistant. Some progress has already been made in this direction but there is little to report for the use of the ordinary grain-grower.

Early maturity in oats is an important consideration as oat-rust is generally most severe in late season.

Good drainage and proper preparation of the soil are important factors in that they aid the plant to overcome the attack of the fungus.

WHY CERTAIN PLANT DISEASES PERSIST

W. Lochhead, Macdonald College

(Portion of an address given at the Summer Meeting at La Trappe)

After many years of close touch with gardeners and fruit-growers, I am convinced that the causes of the persistence of certain plant diseases, in spite of applications of fungicides, are in many instances what might be termed **careless culture.** The great majority of plant-growers fail to realize that many diseases are propagated through the agency of the manure or compost heap. Diseased plants are thrown on the manure pile, or given to hogs as food, but the disease spores are not killed even when the plants are eaten. When the manure is spread on the land the spores are set free, and are ready to attack its host the following season, should it be planted on the manured land. Familiar examples are potato scab and club root of turnips and cabbages. Certain forms of Botrytis flourish on compost heaps, and when this compost is used for greenhouse potting the disease is brought in a favorable position to attack the potted plants.

Crop Rotation and Plant Diseases.—Again, soils bearing certain diseased crops often become filled with the spores that are liberated with the decay of the diseased plants or the ripening of the grain. Smuts, club root, late potato blight and other downy mildews are familiar examples of diseases that may live over in the soil. Evidently in such cases a rotation of the crops will lessen the damage, for very few fungi have acquired the habit of living upon more than one kind of host. The growing of the same crop for several successive years tends to intensify any disease that may attack the crop.

Weeds and Fungous Diseases.—Many of our common, uncultivated plants and weeds are attacked by diseases that are injurious to crops, and are often responsible for the spread of these diseases. For example, several of the grasses are attacked by the common cereal rust ; mustard and shepherd's purse by club root, wild plums by shot-hole fungus and brown rot, wild roses by orange-rust, etc. It is, therefore, unwise to allow weeds and such uncultivated plants as are of no economic value, to live.

Ignorance of the Nature of Plant Diseases.—Further, considerable ignorance prevails as to the nature of fungous diseases. It is not generally known that these diseases are caused by minute plants, called fungi ; that these plants possess a vegetative portion and a reproductive portion ; that it is the vegetative portion—consisting of a number of fine threads—which feeds upon the cells of the plant attacked, and that the reproductive portion is only concerned with the formation of spores. Spraying is applied after the infection of the plant for the purpose of preventing the spores that may be found from infecting fresh leaves or fruit. The chief aim of the grower should be the prevention of plant disease, for cure is hardly possible after infection. There are certain unfoldings of a plant that serve as convenient times for spraying, for example, the unfolding of the leaves in the bud, and the unfolding of the flower buds. These are critical periods in the plant's life, and the young tissues are easily infected by fungous spores at those times.

Clean Culture.—Again, it is very essential that the dead and decaying leaves, fruit and twigs should be gathered and burned, as they often contain the winter spores of many of the most injurious fungous diseases. Neglect of clean culture is one of the weaknesses of the ordinary plant-grower, and it is largely responsible for the persistence of plant diseases year after year.

Fungi and Climatic Conditions.—It is quite probable that the spores of most plant diseases are present every year in greater or less abundance, but that some years offer better facilities for infection than other years. A most important factor in infection is **moisture.** Spores require moisture for germination on leaves or fruit. Moreover, a favorable season for plant growth makes it quite difficult for the fungus, even if infection occurs, to do much harm. On the other hand, if unfavourable conditions for growth arise after a period of rapid growth the fungus makes rapid headway and may do much harm.

THE CONTROL OF THE AMERICAN GOOSEBERRY MILDEW

Sphaerotheca mors-uvae (Sckw) B. & C.

By C. M. Williams, Macdonald College, Que.

The American gooseberry mildew is one of the most destructive pests of gooseberries, particularly the European varieties. In some localities the injury is often so great that the whole crop is ruined.

The mildew appears early in May as a white powdery growth on the leaves and young shoots, gradually spreading to the fruit. This is known as the summer stage and at this time the summer spores are produced in great profusion. These conidia, being extremely light, are easily carried by the wind causing the rapid spread of the disease. Later in the season, the threads of the fungous become dark brown in color forming dark blotches or scabs on the fruit, making it unmarketable. Upon this mycelium, numerous small roundish bodies, the perithecia, are produced, each containing eight colorless spores called asco-spores. These perithecia remain on the twigs or ground all winter, liberating the asco-spores in the spring. The asco-spores are blown to the bushes, infecting them under favorable conditions and causing the reappearance of the disease, thus perpetuating it.

The mildew not only ruins the fruit but also saps the young growth of its vitality, thus preventing the development of the fruit buds, eventually killing the plant. The disease appears to be most prevalent on the twigs and leaves that are shaded.

As a rule, mildews of this class readily succumb when treated with such fungicides as Bordeaux or Potassium Sulphide. The gooseberry mildew, however, is extremely resistant to the action of such fungicides, consequently it is very hard to control.

During the summer of 1910, a series of experiments were conducted by the writer at Macdonald College for the purpose of discovering, if possible, an efficient remedy. European gooseberries of the varieties Industry and Crown Bob were used. The fungicides tested were Lime Sulphur, Potassium Sulphide, and Bordeaux mixture.

The gooseberry plantation was divided into sixteen plots of twenty plants each. Ten plots were sprayed with commercial Lime Sulphur of a strength varying from 1 to 20 to 1 to 35, and received from one to three applications each. Three others were sprayed with Potassium Sulphide (1 ounce in two gallons of water), and received two, three, and five applications respectively. Two more were treated with Bordeaux, receiving two and three applications, and one was left as a check.

At regular intervals throughout the summer, observations were taken and, at harvesting time, the crop from each plot was weighed and the per cent of mildew on the berries ascertained, with the following results:—

The plots receiving three applications of Lime Sulphur of the strength 1 to 20 were by far the healthiest. The bushes made good strong growth, carried abundant foilage, and produced a crop of excellent quality. The mildew was only slightly in evidence, the twigs and leaves being comparatively free while only 7 per cent. of the berries were diseased. The average crop per plot was 52 pounds.

As the dilutions of the Lime Sulphur became greater and the number of applications fewer, the per cent. of mildew gradually increased.

With the Potassium Sulphide sprayings, the results were considerably less satisfactory. Although the plot that received five applications made a fair growth, the berries were undersized and of poor quality, only totalling 42 pounds and were diseased to the extent of 24.2 per cent. As with the Lime Sulphur, the mildew increased as the number of applications decreased.

The Bordeaux sprayings were practically a total failure. The disease was very prevalent on the twigs, leaves, and berries of the plots treated. The leaves fell prematurely thus preventing the proper development of the fruit, consequently it was small and quite unmarketable. The average crop of two plots was 31 pounds with 93 per cent of the berries diseased.

These results show that Lime Sulphur is a much more efficient fungicide for controlling the mildew than either Potassium Sulphide or Bordeaux. As the best results were obtained when three applications of Lime Sulphur, of the strength 1 to 20, were given, on April 16, May 16, and June 16 respectively, we may conclude that these sprayings followed by a thorough application after the crop is harvested, will insure a crop of good quality and practically disease-free.

SOME SCALE INSECTS OF STE. ANNES

By William H. Brittain, Macdonald College, Que.

Scale Insects is the name commonly applied to the members of that family of insects known to the scientific world as Coccidae. They constitute a family of the sub-order Homoptera of the order Hemiptera, to which group the plant lice, tree hoppers, etc., also belong.

The family Coccidae contains species which differ so widely among themselves, that the task of framing a definition which will suit all forms is a matter of considerable difficulty. They may be distinguished from all related families by the tarsi in all except two abnormal genera consisting of a single segment provided with a single claw; by the females being always wingless, and with head and thorax united; and by the males being two-winged, without a mouth and undergoing a complete metamorphosis. In a general way it may be said that Coccidae are degraded insects, with wingless stationary females, and with two-winged, rarely wingless males. They are usually quite small insects, scale-like or gall-like in form, or grub-like and clothed with wax.

Though the casual observer would never think of associating the dried, motionless bodies of most adult female coccids with insects, the larvae are active, possess all the characters of typical insects, and would not be mistaken for anything else.

The family coccidae is represented in this district by four sub-families. These may be separated by the following simple key:

Diaspinae

A. Body of adult female covered by a leaf-like disc of secretion.

AA. Body of adult female not covered by leaf-like disc of secretion.

Lecaniinae

B. Abdomen of adult female longitudinally cleft at apex, with a pair of triangular plates at base of cleft.

BB. Abdomen of adult female not longitudinally cleft at apex.

Dactylopiinae

C. Insect active throughout life.

Kermesinae

CC. Adult female stationary.

There have been, in all, about thirty species of scale insects collected in the neighborhood of Ste. Anne's. The majority of these, however, either infest trees or shrubs of little economic importance, or else do not occur in sufficient numbers to do much damage. It is the purpose of this article only to mention those species of special interest to the farmer and horticulturist, and to outline very briefly the methods to be employed for their control.

Belonging to the Diaspinae group the common oyster shell scale (Lepidosophes ulmi) is first in importance. This scale, as its name suggests, resembles an oyster shell in shape. It is brown in colour, covered with a sort of bloom which gives a perfect specimen a greyish appearance. The body of the female itself, which will be found beneath the scale, is yellowish white in colour, elongated and distinctly segmented. Like other Diaspinae it is quite devoid of legs or eyes.

If the female scale be inverted during the winter months, it will be found to be filled with small, oval, yellowish-white eggs, closely packed together, and varying in number from about forty to one hundred, while at the cephalic extremity will be found the dead and shrivelled body of the female. The eggs hatch shortly after the time the apple blossoms fall, and for a short time the young larvae may be seen moving over the host plant. During their active period the larvae sometimes wander as far as the fruit and there secrete their scales. Like other Diaspinae the female moults twice in the course of her life. The eggs are laid in the fall. This insect is quite common here on apple and other trees.

Another insect of this group which occasionally proves injurious to orchard trees is the Scurfy Scale (Chionaspis furfurus). The scale of the female is dull, opaque white in colour. It is broadened behind and suddenly narrowed in front. As in the preceding species, the cast skins are found at the anterior extremity. The eggs of this insect are purplish in colour. Its life history is much the same as that of the oyster shell scale.

Still a third orchard pest belonging to this group is found here. This is the Curtis Scale (Quadraspidiotus ostreaeformis). The adult female scales of this insect are nearly circular in outline. They are generally light grey in colour, and the large orange-coloured cast skins are nearly, or quite, central. The margin of the scale is much lighter in colour than the rest. Sometimes the entire scale is dark gray. The young forms are black, and have a whitish ring about the central portion.

Remedies.—Not having the dreaded San Jose Scale to contend with the treatment of these insects in orchards is a comparatively simple matter.

The winter strength of the lime-sulphur wash sprayed on the dormant wood early in spring is generally sufficient to destroy the Scurfy and Curtis scales, and to prevent the Oyster Shell Scale from becoming injurious. If, however, this last named insect should still prove troublesome, a spray of kerosene emulsion applied when the young larvae emerge will finish the work.

Representing the family Lecaniinae we have the common soft scales of our greenhouses. Two of the most common of these are Coccus hesperidum and Saissetia hemisphaerica. The former is a rather flat, oval insect, yellowish brown in colour, smooth and shining. It is viviparous, i.e., it gives birth to living young. The latter, which is commonly known as the hemispherical scale, is darker in colour, and in shape almost hemispherical, the entire body cavity being filled with eggs at maturity. These insects may be kept in check by treating the affected parts with strong soap suds.

To the sub-family Dactylopiinae belong the so-called "mealy bugs" of our greenhouses. The most common species is known as Pseudococcus citri, the Common Mealy Bug. It is a small oval insect with a fringe of white waxen filaments placed around the margin of its body.

The Long-tailed Mealy Bug (Pseudoccocus adonidum L.) resembles the preceding in appearance, only the last four marginal filaments are much elongated, being sometimes as long as the body of the insect.

Remedies.—Frequent spraying with cold water is generally sufficient to keep these insects in check. Should they still prove troublesome, spraying, or dipping in strong soap solution, fish-oil or other, or where the plants are not too tender, with kerosene emulsion, is effective.

Representing the sub-family Kermesinae, we have in this district a species of the genus Kermes, found on oak trees. The adult females are large and gall-like.

Those in this district have been almost, if not quite, exterminated by one of their parasites—the larva of a small moth.

NOTES ON TWO INJURIOUS BEETLES

By Albert F. Winn, Westmount

The season of 1910 was such an unsatisfactory one for the city amateur entomologist who has little time or opportunity for field experimental work, that we should like to forget the year's existence altogether.

However two short notes may be of interest. Early in June I had a telephone message from a neighbour asking about a "bug" that was eating up all their raspberry flower buds. On going over, although too dark that evening to see much, we found a few of the beetles and plenty of evidence of their work. It was seen that the insect was the well-known Raspberry flower beetle, or pale brown Byturus—technically Byturus unicolor, Say. The beetle is only a little over $\frac{1}{8}$ of an inch long, pale brown in colour, covered with fine yellowish hairs. It belongs to the family Dermestidae, nearly all of which live in stored animal and vegetable products such as hides, bacon, tallow, carpets, museum specimens etc., and of which a well-known example is the Bacon beetle, Dermestes lardarius.

The Byturus is the exception to the rule and makes a practice of finding the raspberry bushes just before the flower buds open, eating a hole in the side and attacking the receptacle, usually destroying over half of it, and the stamens. The eggs are laid in the blossoms and the white maggot-like larvae feed in the fruit, so that the flower attacked is utterly ruined, part by parent, part by its offspring.

Knowing the insect's early rising propensities, I went out before breakfast to look over some wild raspberry plants near my house and found quantities of the little beetles, apparently more beetles than flowers. A bush of Spiraea Van Houttei in my garden was also alive with them, the least jarring of the canes or twigs causing them to tumble off or take to flight.

They only lasted for a few days, so that probably about the best remedy would be by jarring the branches early in the morning and perhaps again at sun-down, over an inverted umbrella and destroying the beetles. My friends found that they left some varieties of raspberries alone, others were completely spoiled. The wild ones mentioned produced practically no fruit. Fortunately it is seldom that the insect appears in sufficient numbers to do a great amount of damage and in this instance the attack was apparently local as there was no outbreak at the Experimental Farm at Ottawa.

The other beetle I wish to mention is a true leaf-eating species—a flea-beetle, but one not so familiar as the Byturus. Its food plant is the Horse-radish and it is a European pest. There appears to have been no published record of its occurrence in Canada, until I called attention to it in a short note at the annual meeting of the Entomological Society of Ontario last fall, though it has undoubtedly been present for several years.

Last spring I purchased a few roots of the plant at Bonsecours market, which I planted, and in due course leaves appeared. Before they were more than a few inches high, round holes were seen in them, surely the work of a flea beetle. An examination showed plenty of them, but the species was quite unfamiliar. About ⅛ inch long, oval shaped, with light creamy wing covers, bordered with a narrow black band around the margin and a much wider one down the suture, broadest at the middle. The whole insect has a very bright shiny appearance as is usual among the flea beetles. The thorax and wing covers are densely pitted with punctures.

A reference to the literature revealed its identity, through an article in Insect Life, Vol. VII, in which Mr. F. H. Chittenden called attention to the first recorded capture in the U. S. in vacant lots close to the grounds of the Columbia Exposition at Chicago in 1893. Whether it has spread eastward from that neighbourhood like its relative the Colorado potato beetle, or whether we have had a separate infestation from Europe, we cannot even guess, but in any event we have it among us, and some people who dislike horse-radish are unkind enough to say they hope it will continue to confine its attentions to that plant and eat it all up. Personally I feel that my investment of five cents at the market gave me more pleasure in leading to the discovery of an injurious beetle new to Canadian records than I would have obtained from the enjoyment of the tasty roots with my roast beef.

ON INSECTS OF FORESTS AND WOODLANDS

J. M. Swaine, Macdonald College.

Everyone knows that our forests and woodlands team with insect life in many forms. Certain of these species are notoriously destructive; while a host of others cause a large, though less apparent, annual loss. It may be said that all our forest trees are subject to attack by a large number of injurious insects, which may be found at certain seasons ovipositing in the bark, or on the leaves, or feeding upon the leaves, the bark or the wood. All parts of the trees are affected, from the roots to the summit; borers in the bark and wood, leaf-eating caterpillars and saw-fly larvae, scale insects and aphids innumerable.

Usually most species are kept down to moderate numbers by insect enemies, fungous diseases, birds and adverse weather conditions; but, at times, nature appears to relax her usual vigilance and the pests breed to such numbers that widespread devastation results.

No careful study has been made of insect injuries to our Canadian forests and therefore no reliable estimate can be given of the damage annually incurred. From the reports of collectors and others familiar with our forests we do know, however, that the annual loss from forest insects is very great, unquestionably amounting to many millions of dollars. Although our climate doubtless acts as a check on the spread of certain injurious insects, our forest area is so great that there seems to be no good reason for believing our annual loss from this cause to be much less than that of the United States, an estimate of which is given here.

Much of the injury to our forests of course occurs in remote districts where the trees are of no present commercial value; but many such regions must be tapped by the lumberman during the normal lifetime of this generation of pine and spruce.

Estimated annual loss to U. S. forests from insects, prepared several years ago by Dr. A. D. Hopkins, of the U. S. Bureau of Entomology:

Bark-beetles to pine and spruce	$5,000,000
Bark and Timber beetles, causing defective wood in felled timber	$1,000,000
Insects in timber injured by fire, etc.	$1,000,000
Columbian Timber beetle	$1,000,000
Carpenter Worm, etc., in oak	$2,000,000
Chestnut insects	$1,000,000

Long-horned Wood-borers to standing timber	$2,000,000
Same to felled timber and saw-logs	$2,000,000
Other Wood-borers	$2,000,000
Foliage-infesting insects	$3,000,000
White Pine-weevil, etc., to young growth	$1,000,000
Powder Post-beetle to dry and manufactured wood	$1,000,000
Miscellaneous insects not included in above.	$3,000,000

This gives a total of $25,000,000. If to this be added the losses from using and in working up defective wood, and in diminished forest area caused by insect ravages, the total would be nearly $100,000,000. Dr. Hopkins estimates that if the trees which have been destroyed in the United States in the last fifty years by beetles of one genus, Dentroctonus, were living to-day their stumpage value would be nearly $1,000,000,000.

Familiar examples of wide-spread damage by insects in our own forests are: the destruction of spruce and pine in the New Brunswick forests during the last century by the spruce-destroying bark-beetle, Dendroctonus piceaperda; destruction of larches over all eastern Canada by the larch saw-fly; the injury to spruce in Quebec, Ontario and British Columbia by the spruce bud-worm; the work of the birch saw-fly in Quebec and New Brunswick, and the devastation of oak foliage in Quebec last season by Anisota senatoria. An immense amount of timber is seriously injured every year by the boring of beetles and their young. Everyone has noticed the "pin-holes" caused by insect larvae, so common in wood of cheap furniture and house fittings, and the larger rounded or flattened holes, caused by cerambycid or buprestid larvae in lumber.

Trees may be injured or killed outright, and when many trees are killed over a wide area forest fires frequently complete the work of destruction. It has been shown that in the denudation of extensive areas in the United States the work of beetles was in certain instances the primary cause, fires having merely completed the work. In certain sections of North America the damage to forests from insects is quite as serious a matter as is the loss by fire.

Shade trees being in a measure isolated, suffer even more severely. Orchard insects and shade-tree insects can be controlled by spraying, cutting out of borers, and other methods too costly to be employed with profit over a wide area. But, although the subject has been as yet too little studied, practical means have been devised for the control of some of the most serious enemies of the forest. In the carefully policed European forests, the injurious insects have been fairly well controlled for many years. The forest insects of those countries have been so thoroughly studied, the species and their habits are so well-known, that the foresters there are able, at the *beginning* of an outbreak of any pest, to set in operation, at once, previously devised methods for control; and at a small expense to prevent widespread destruction. In America the greater part of this work has been done under the direction of Dr. Hopkins of the U. S. Bureau of Entomology, and his results are summarized in bulletin 83, part 1, of that Department.

Perhaps the most serious insect enemies of coniferous forests are beetles of the Family Scolytidae. The true bark-beetles, the most injurious of the Scolytidae, breed within the bark and sap-wood, and have destroyed, during the past hundred years, billions of feet of the most valuable pine and spruce in the United States and Canadian forests. They hibernate within and beneath the bark of infested trees. They prefer, as a rule, trees in poor health or in a dying condition, but certain species readily attack and destroy perfectly healthy trees when in immense numbers. The methods of control in this instance include modifications of the logging operations and are directed, not towards extermination, but to such a reduction in the numbers of the beetles that the normal amount of dying bark and wood will satisfy their desire for breeding purposes. In a badly infested area, infested trees, which are easily distinguished, are chosen for cutting. The cutting is done, as far as possible, in winter. The infested logs are barked before the beetles emerge therefrom in the spring, or the logs are put in the water early, instead, so that contained insects are killed. The bark and all infested branches are burnt. In addition certain healthy trees are chosen in the spring for cutting later, and hack-girdled. These trees, being in a dying condition, attract the beetles for breeding purposes during the summer, and serve as traps in which the beetles may be killed, as outlined above. These and other such methods are indicated by the life history of the species causing the trouble; and careful study of the life history must be made in each instance, the details varying with the species and with the latitude, altitude, and other locality conditions. The Ambrosia-beetles, or "Timber-beetles," also belonging to the Scolytidae, drive their tunnels below the wood surface, and are responsible for the black "pin-holes" which reduce in value so much of our pine, spruce, birch and oak lumber.

Beetles of the families Cerambycidae, Buprestidae, and others, lay their eggs in the bark of diseased standing trees, and felled unbarked logs. The larvae or grubs which hatch from their eggs cut winding tunnels through the sap-wood, and later, deep within the tree. This injury is most noticeable in logs left in the woods until late in the season. Barking such logs before the 1st of June prevents the injury.

Certain forest insects cannot be controlled by any practical method so far devised; but much has been done, and much more can be done towards controlling the most injurious forms. The basis of all such work must be, however, careful study of the species and life-histories of our Canadian forest insects. This work can only be completed by trained entomologists, in co-operation with the lumbermen and others familiar with logging methods; but anyone interested in forest insects can assist by recording habits and life-histories.

Any effort which would check the present wholesale destruction of our insect-feeding birds would have an immediate effect in lessening the damage from insect pests. The great number of insects so troublesome of late years about many of our cities and towns is without doubt a direct and well-deserved result of the indiscriminate murder of our insectivorous birds.

Parasitic and predaceous insect enemies of injurious insects have been effectively used for checking insect ravages. A Lady-bird Beetle brought from Australia effectively controlled the extremely injurious Cottony Cushion Scale of California. Thousands of dollars are now being spent by the U. S. Government in importing and breeding parasitic enemies of the Gypsy Moth and Brown Tail Moth, so injurious in some of the New England States.

The injurious insects find their opportunity to breed to destructive numbers through the agency of great storms and fires, which leave many trees in an injured and dying condition. In all the settled parts of the country and in our timber-limits, man's carelessness has been quite as favorable to insect increase as even forest fires. Tops, branches, and worthless remnants are often left to breed hordes of insects under the most favourable conditions.

Much of the insect injury in wood-lots can be prevented by a careful system of clean culture; all dead and dying wood should be trimmed out, and burned before the contained insects can emerge in the springtime to spread the infestation. Dying trees with the bark filled with borers should be cut and barked before the young transform to the adults. The drying of the bark, especially if in the sunlight, rapidly kills the grubs.

AN OUTLINE FOR THE CONTROL OF GARDEN AND ORCHARD INSECTS OF QUEBEC

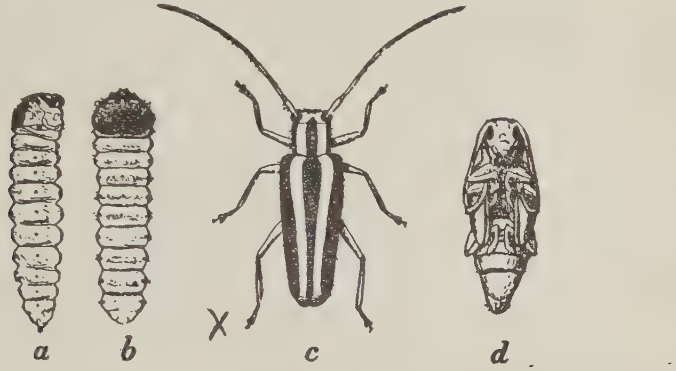
J. M. Swaine, Macdonald College

Orchard Insects

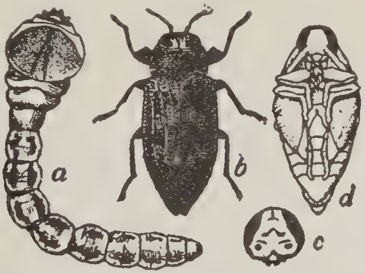
The numbers refer to insecticides at the close of the paper.

Apple Woolly Aphis, Schizoneura lanigera.—white woolly masses on trunks and branches, rarely on the roots in the North.

Control.—No. (13) driven in a strong spray.



The Round-headed Apple-tree Borer (Saperda candida, Fab.): **a,** larva, from side; **b,** from above; **c,** female beetle; **d,** pupa. (All enlarged one-third.)—(From Chittenden.)



Flat-headed Apple-tree Borer (Chrysobothris femorata, Fab.): **a,** larva; **b,** adult; **c,** front of head; **d,** pupa. Enlarged.—(After Division of Entomology, U. S. Department of Agriculture.)

Round-headed Apple-tree Borer, Saperda candida:—Sunken discoloured patches on bark of the lower trunk of apple-trees in early fall, with borings projecting from cracks. Later the openings are larger, and much dust may be ejected. Smaller trees may be girdled and killed, or so weakened as to break in storms.

Control.—Watch for the borers in early fall, and remove with a sharp knife. Later they may be killed by work with a knife and wire, or by injecting (3) or (6) into the tunnels and sealing the openings with clay. Egg-laying may be prevented imperfectly by use of (1).

Flat-headed Apple-tree Borer, Chrysobothris femorata:—More widely distributed on trunk and larger branches.

Control.—Use of (1) and as for the Round-headed Borer. Branches of hickory or oak scattered in May about the edges of the orchard would trap the greater part of the eggs, as these trees are preferred for oviposition. The branches should be burned later in the summer.

The Oyster-Shell Scale, Lepidosaphes ulmi:—This is our common injurious orchard scale. It does much damage in neglected orchards, and should never be allowed to become numerous. It sucks the sap and must be killed by a contact spray.

Control.—Lime sulphur, spring strength, has some effect upon it, but needs to be supplemented with an application of (9) or (13) or (14), as the young lice are crawling about in early summer. Watch the trees, and when the tiny whitish nymphs are crawling about the old scales, spray the trees at once. No. (17) is also effective.

The Bud Moth, Tmetocera ocellana. A tiny brownish caterpillar found feeding upon the opening buds, and later upon the leaves. Very injurious when in great numbers.

Control.—When a special application is required, (15), (22), or (13) will be effective. In a measure controlled by the regular spray of lime-sulphur, spring strength, which should always be given to apple orchards before the leaf-buds start.

The Cigar Case-bearer, Coleophora fletcherella:—Tiny caterpillars in cigar shaped cases feeding upon leaf-buds, and later upon the open foliage.

Control.—As for the Bud Moth. Better to use (13) when very numerous, and apply early.

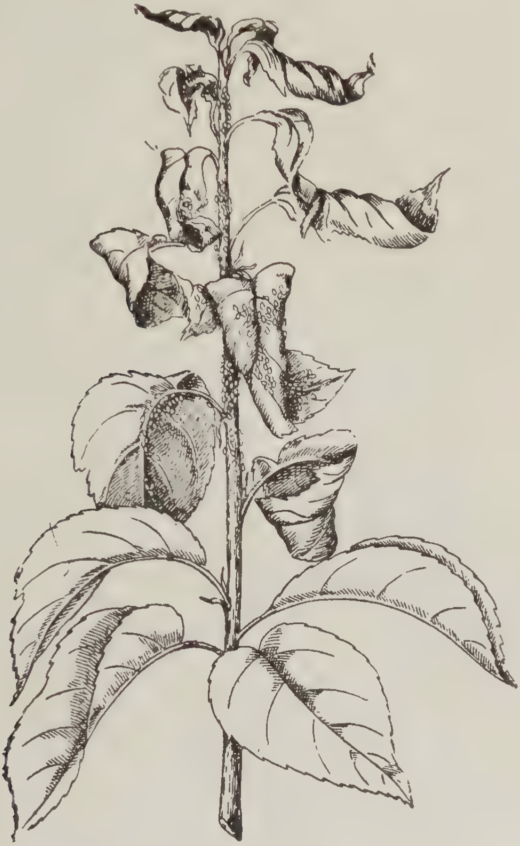
The Pistol Case-bearer, Coleophora malivorella, has the same habits. Its case is shaped somewhat like the handle of an old-fashioned horse-pistol.

Control.—As for the Bud Moth. Better to use (13) when very numerous.

The Canker-worms, Alsophila pometaria and Paleacrita vernata:—Small looping caterpillars feeding upon the leaves early in the season. When numerous they may strip the trees and do much injury.

Control.—The most satisfactory method is to watch the trees, and spray thoroughly with (15), 3 pounds per barrel, **while the caterpillars are small.**

The Apple Aphides. Several species of plant-lice infest the apple-trees of this Province. They injure young trees most seriously, and should never be allowed to check the early growth. It is very difficult to control them after the leaves are curled.



Terminal shoot of apple infested with the Apple Aphis showing condition of leaves. (After Quaintance).

Control.—Watch the trees early in the season, and if the young are numerous on the opening buds and young leaves, spray at once, thoroughly, with (9), (13) or (14). A spray of the same the 2nd week in October will effectively check them for the succeeding season.

Aphides on the other trees are usually controlled readily by spraying the foliage, before the leaves have curled so as to enclose and protect the pests, with (9) or (13).

The Apple-tree Tent Caterpillar, Malacosoma americana:—The brownish hairy caterpillars, distinguished by the whitish band along the middle of the back, construct neat tents in the forks of the branches. They leave the tents during the sunshine to feed on the neighboring leaves. The tent is gradually enlarged and much of the branch may eventually be stripped of leaves. These caterpillars are found only early in the season, and pupate early in July.

Control.—Remove the tents while small, while the caterpillars are within, and destroy the contained caterpillars; or spray the infested branch with lead arsenate or Paris green. The tents may be destroyed and the caterpillars within by means of a torch on a long pole.

The Fall Web-worm, Hyphantria textor:—Smaller, brownish, hairy caterpillars, spinning a rough unsightly web over the branch. The web is extended to cover the feeding ground of the gregarious caterpillars and forms a rough tent which may eventually cover a large branch. These are tent-making caterpillars found in August and September on forest trees and many shade trees.

Control.—As for the Apple Tent Caterpillar. The tents should be removed while small.

The Yellow-necked Apple-tree Caterpillar, Datana ministra:—A dark colored, striped, hairy caterpillar with a yellow ring about the neck. It is gregarious and has the habit of retracting the head and tail over the back when disturbed. They will rapidly strip a branch, and migrate to another.

The Red-Humped Apple-tree Caterpillar, Schizura concinna:—A reddish-yellow caterpillar with a conspicuous hump behind the head. It is gregarious and common on apple foliage, stripping the branches rapidly.

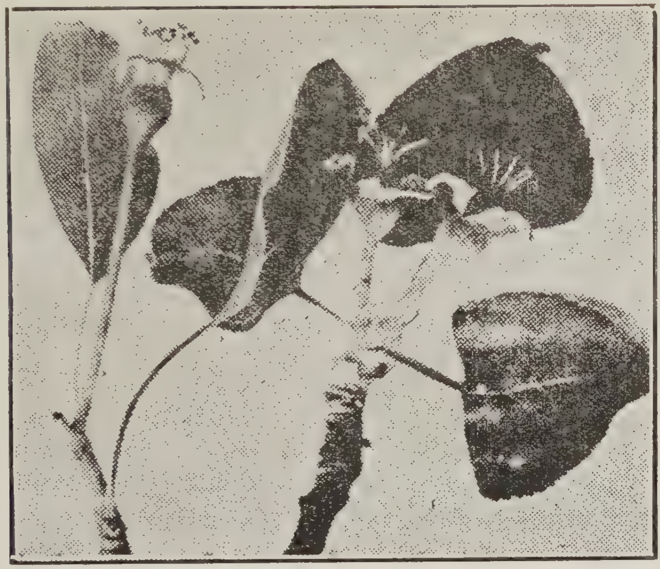
The Hickory Tiger Moth:—A gray and black tufted caterpillar, common on fruit and shade trees throughout the summer. It is gregarious when young, but isolated when near full-grown.

Control.—All leaf-feeding caterpillars are easily controlled by spraying their feeding-grounds with (15) or (22).

The Pear Slug, Eriocampoides limacina:—Small, yellowish or brownish, slug-like, slimy saw-fly larvae skeletonizing the leaves. The injured portions of the leaves turn brown. Injurious when in large numbers.

Control.—"Slugs" of this kind on fruit-tree foliage may be readily destroyed by spraying with (15) or (22) more dilute than usual; or by scattering air-slaked lime over the infested foliage. Even fine dry road-dust thrown over the trees will kill great numbers of them.

The Codling Moth, Carpocapsa pomonella: The larva or caterpillar is the commonest of our apple-fruit pests. A small pinkish caterpillar with three pairs of legs just behind the head, and five pairs of prolegs on the abdomen. It works mainly around the core, and emerges usually through a hole cut in the side of the fruit either before or after the fruit falls. The adult is a beautiful chocolate-brown moth, seldom seen, which lays its eggs on leaves or small fruit shortly after the falling of the petals. The young caterpillar must penetrate the fruit to feed, or perish. Three-fourths or more enter through the calyx end, feed first within the calyx cup, then usually closed, and penetrate the apple to the core. There is one brood each year in this Province, excepting that a partial second brood may occur in southern Quebec and account for some of the late wormy apples.



Just right to spray: A pear and two apples from which the petals have recently fallen. Note that the calyx lobes are widely spread. Spraying time for Codling Moth.—(After Slingerland).

Control.—In untreated orchards this pest frequently injures from one-half to four-fifths of the crop. The control is simple and effective. **Spray with 18a** (or 22a) **within ten days after the falling of the blossom petals.** Spray thoroughly with a high pressure, taking care to drive the spray into the calyx cups. The work must be done before the calyx cups at the outer end of the apple close. The object is to fill those cups with poison while the apples are upright, and before the cups close. The calyx lobes will then, when they shut, enclose enough poison to kill the caterpillars which seek to enter there, perhaps weeks later. This one spray, if properly done, will prevent three-fourths of the injury. A second application two weeks later is of doubtful value in this Province, so far as the control of this insect is concerned, but may be a good investment if the largest amount of fine fruit is desired. (See control of the Plum Curculio.)

The Plum Curculio, Conotrachelus nenuphar:—A small, blackish, roughened snout-beetle which feeds upon the young, forming fruit, and lays its eggs in crescent-shaped slits upon their sides. These holes and slits cause a deformity in the fruit, and the larva or grub feeds within somewhat after the manner of the Codling-worm. The infested apples fall usually before the grubs leave them to pupate in the soil. There is one brood each season. This insect is more serious than even the Codling-worm in a few Quebec localities. It is also a chief pest of plums wherever they are grown.

Control.—As the eggs are laid beneath the skin of the fruit, there is no method of reaching the grubs. Control must be directed against the adults in the early season if injury is to be prevented. Some success is obtainable by poison sprays. The second apple spray of the calender should, when this pest is expected to be numerous, contain lead arsenate, four pounds to the barrel. The next application, immediately after the blossoms fall, should contain the same, three pounds per barrel. It is better, if the attack is severe, to apply the fourth spray carefully, three pounds of arsenate per barrel. *Careful destruction of all fallen fruit* (*as soon as possible, before the grubs leave the apple*), will do much towards checking the pest for the following season.

This insect breeds also in plums and usually will lay its eggs in plums in preference to apples. Therefore a few plum trees in an apple orchard may be used as traps to draw the beetles from the apples. The wormy plums should, of course, be rigidly and promptly destroyed; and the plum tree should be kept covered with lead arsenate while the fruit is forming, to kill as many adults as possible. In controlling this pest on plums use lead arsenate, three pounds per barrel (see calendar).

Jarring plum-trees and small apple-trees during the curculio season will largely prevent injury. The beetles drop to the ground when disturbed. Spread a large white cloth, or other contrivance beneath the tree and strike the trunk and larger branches with a wadded mallet. Gather and destroy (drop in a pan containing kerosene) the beetles which are thus collected. The jarring is most effective when done early in the morning while the beetles are sluggish.

The Apple Maggot (Railroad Worm), Rhagoletis pomonella:—This insect is not yet widely distributed but is, whenever present, the most serious apple pest. Every effort should be made to control it as soon as it is discovered. The adult is a small, two-winged fly with dark bands across the wings. The eggs are laid beneath the skin of the apple fruit, and the larvae or maggots bore tiny winding tunnels throughout the pulp. The smaller, pointed, jawless and footless maggots are easily distinguished from the larvae of the other apple fruit pests and the winding tunnels penetrating the pulp in all directions can hardly be mistaken.

Control.—There is only one effective method so far devised. Gather promptly, and destroy all fallen, infested fruit. Boil the fruit and feed it to stock. If this is carefully done the infestation can be greatly reduced in one year, and in a few years entirely controlled. Co-operation is necessary in adjoining orchards.

The Apple Curculio, Anthonomus quadrigibbus:—This insect is not so common in Quebec, as an apple pest, as is the plum curculio; but it does serious damage at least in the Covey Hill district. The adult has a longer snout and also differs from the Plum Curculio in having four humps on the back arranged roughly in the form of a square. The eggs are laid in a simple cut, without the crescent-shaped slit of the plum curculio. The pupa is formed within the fruit, instead of in the ground as with the Plum Curculio. The larva or grub has a distinct "hump" behind the head, and can be so distinguished.

Control.—As for the plum curculio. Destruction of wormy fruit is particularly important.

Insects of Small Fruits

The Imported Currant Worm, Pteronus ribesii.—The common "currant worm", too well known to need description. The adults, four-winged flies known as "saw-flies," lay the eggs in spring on the under sides of the leaves in rows along the midribs. The larvae at first cut rounded holes through the leaves, and later strip the bush completely unless controlled. There is a second brood later in the season.

Control.—Spray the bushes with (15) or (22). After the fruit is half grown, use (21), a or b., or (11).

The Currant Span-worm, Cymatophora ribearia.—A looping, yellow and black spotted caterpillar feeding voraciously on currant and gooseberry foliage. There is one brood each season.

Control.—As for the "Imported Currant Worm." These are rather more difficult to kill than the more common "Imported Currant Worm" and the insecticide should be more carefully applied.

The Currant and Gooseberry Fruit-worms, These fruits are attacked by small caterpillars which are occasionally present in great numbers feeding within the berries.

Control.—Gather and destroy infested berries as soon as noticed. Rake up and burn rubbish beneath the bushes in the late season, to destroy the hibernating form. Poultry will pick up many pupae, if allowed the run of the patch in the Autumn.

The Currant Borer, Sesia tipuliformis.—Small, clear-winged moths with blue-black bodies and a yellow-banded abdomen, lay eggs in midsummer on currant canes. The caterpillars penetrate the canes and feed upon the centre, leaving a long, black tunnel, which greatly weakens the cane and usually kills it. The caterpillars winter two-thirds grown, and begin work very early in the spring. They pupate within the tunnels, and may later project from a hole which the caterpillar has cut through the side of the cane, and emerge as moths in June.

The injury appears commonly about Montreal Island, and should be watched for by all currant growers. It is the most serious enemy of the currants.

Control.—Cut out and burn the infested canes as soon as they begin to wilt. Usually, they may be distinguished in May, two weeks or more before the moths emerge. Whether wilted or not the infested canes may be distinguished during May by the holes in the side, cut by the larvae before pupation. *Root up and burn all worthless currant bushes.*

The Raspberry Cane-Borer, Oberea bimaculata.—A slender, black beetle, with yellow prothorax and long antennae, lays its eggs in the tips of the canes about the middle of June. Two rings of cuts are made a few inches below the tip and the egg inserted in a slit between them. The grub bores within the cane which speedily wilts above the cuts. Only serious when in great numbers.

Control.—Break off the injured tips as soon as noticed, or prune out the infested canes in Autumn.

The Currant Aphis, Mysus ribis.—Tiny plant-lice suck the juice from the leaves of the currant, and when numerous, as they usually are, cause much curling of the leaves, and render those infested practically useless to the plant.

Control.—Watch the aphides in the early season, and as soon as they are noticed spray thoroughly, covering the under side of the leaves, with (9) or (13) or (14).

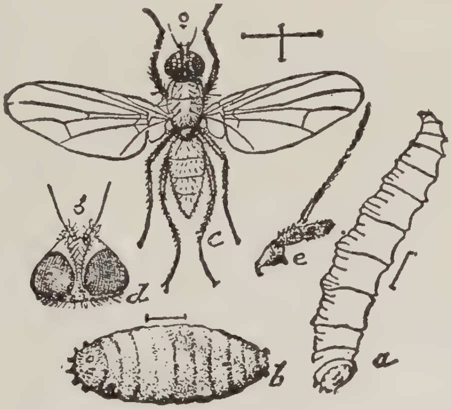
Strawberry Insects.—The chief insect enemies of the strawberry in this Province are the "white grubs," the larvae of the May-beetles. They feed upon the roots and locally cause serious injury. Their habits are discussed under "white-grubs."

Control.—If white grubs are plentiful in the district, do not plant sod-land to strawberries less than three years after breaking. Dig up the grubs from about the injured plants. Plow up the patch after the second crop is removed.

Other strawberry insects, of minor importance with us, are partially controlled by mowing and burning over the patch as soon as the first crop is off, and by taking but two crops from the plants.

Vegetable Insects

The Cabbage Root Maggot, Pegomya brassicae.—Small, dark-coloured, two-winged flies, lay their eggs early in June at the base of cabbage, cauliflower, turnips, radishes, etc. The maggots, when hatched, bore into the root and cut tunnels through it in all directions. Cabbage and cauliflower can hardly be grown without treatment in many localities on account of injury by this pest.



Cabbage Maggot; a, larva; b, pupa; c, adult. (Riley).

Control.—The object must be to prevent eggs being laid near the plant base, or to kill the maggots as soon as hatched, and before they enter the roots.

Control.—**Tarred-paper or felt discs.** Small cards of tarred paper or felt, three inches in diameter and slit to the middle, are carefully placed about the base of cabbages and cauliflowers at the time of setting. Eggs laid beyond the edges of the card need not be considered. This is the most effective control with cabbage and cauliflower. Instead of the cards, no. (11) is used with effect. Various remedies have been recommended, but these two seem the most reliable, and of these the cards are to be preferred.

No. (5) is used effectively by some growers on cabbage and cauliflower, and also on radishes and onions.

To obtain clean radishes use (11) or (5), and make frequent sowings. Destroy all remnants of cabbage and cauliflower as soon as the crop is off, and do not plant those crops in ground infested the previous season.

The Onion Maggot, Phorbia cepetorum.—The onion-plants are attacked by this maggot soon after they are up. The maggots penetrate the stems and are then practically out of reach, so that any remedy must be applied promptly.

Control.—The Onion Maggot is difficult to control. For remedies see (5), (11), and (16.)

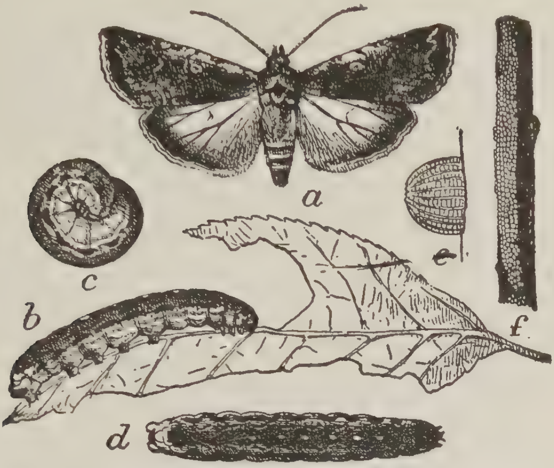
The Colorado Potato Beetle, Leptinotarsa decimlineata.—The beetles hibernate in the ground and appear about the time the potato plants are up in the spring. The yellow eggs are laid on the potato-plants or on near-by weeds. The yellowish grubs feed voraciously until full grown and then pupate in the ground. There are several broods each season. Both adult beetles and larvae (grubs) feed upon potato, tomato, nicotine, nightshade, etc.

Control.—When the beetles are very destructive to the appearing plants, drench each plant with (15), five pounds to the barrel, or hand-pick the beetles, until the leaves are large enough to carry considerable poison.

Later, spray as required, (15), three pounds to the barrel. The poison should be added to the fungicide to ward off blight by the same spray (see calendar). Better results are obtainable by applying the 3 pounds in two sprays, 1½ pounds to the barrel, the second application made as soon as the first is dry. Spray carefully and cover every leaf with the poison.

Cut-worms, various species. Earth coloured, soft-bodied caterpillars, winter in the ground partly grown, and attack young plants of beets, turnips, corn, cabbage, and many other crops, either cutting off the plants at the surface of the ground, or climbing the plant to feed upon the leaves. They are extremely destructive when numerous. They feed by night and hide just below the surface of the ground during the day.

Control.—If they are to be expected, sow (23) broadcast over the field in the evening several days before the plants are up. When injurious to fields of beets, turnips, or like-growing crops, scatter (23) along the rows near sundown. When they attack isolated plants such as cabbage and tomato, drop small portions of the same at the base of each plant near sundown. When properly applied this is a very effective method of control.



Peridroma saucia. a, adult; b, c, d, full grown larve: e, f, eggs. All natural size except e, which is greatly enlarged. (From Yearbook U. S. Dept. Agric. 1898) Life history of a cutworm.

The Cucumber Beetle, Diabrotica vittata.—This is a small beetle two-fifths of an inch long, yellow above with black stripes. The chief injury is done by the hibernated beetles feeding upon the young plants. For the first few days after they appear they feed voraciously upon squash, melon, pumpkin, and cucumber. When numerous they are very destructive.

Control.—These beetles usually refuse to feed on foliage sprayed with Bordeaux mixture; and they prefer squash to any other food plant. The proper treatment of cucumbers and melons is to have growing about the edges of the patch, or scattered through it, if large, a few squash plants. These should be well started before the main crop is upon the ground. The flowers may be kept picked from the squash to avoid effect on melon seed. These squash "trap plants" should be covered with a strong spray of (15) as soon as the beetles appear. Dusting heavily with Paris green will answer the same purpose. While the beetles are hungry they will eat enough poison to kill them. As soon as the melons or cucumbers are on the ground they should be covered with Bordeaux Mixture, and should be kept covered while the beetles are feeding. This has proved a very effective method of control.

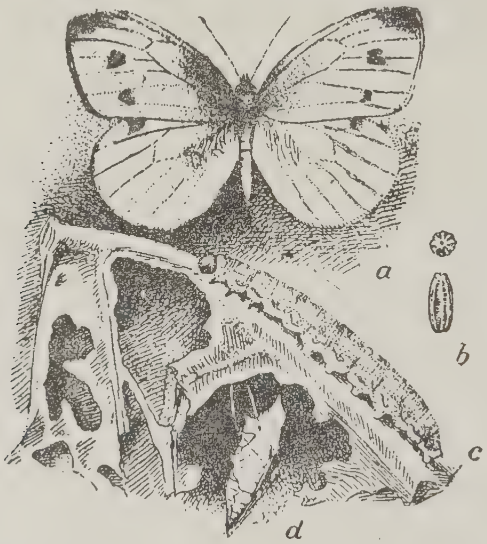
To protect squashes the same method is followed. The main crop is kept covered with Bordeaux, and a few trap-plants treated as described above. When only a few plants are grown, or when the value of the crop will warrant it, it is better to cover the plants as soon as the beetles appear with cheesecloth or wire screens and keep them covered until the first beetles have disappeared.

The remains of all cucurbits should be destroyed as soon as the crop is off.

The Cabbage Worm (young of the cabbage Butterfly), Pieris rapae:—This is the common, green caterpillar or "worm" of cabbage, turnips, and allied plants. It breeds throughout the season.

Control.—Spray the plants as often as required with (15); or dust with (21.b) rather than (15) after the heads are well formed. Other cabbage caterpillars are controlled by the same method.

The Cabbage Aphis, Aphis brassicae.—These plant-lice become very numerous in certain seasons and may need special treatment.



Pontia rapae: **a,** Female butterfly; **b,** above, egg as seen from above; below, egg as seen from side; **c,** larva in natural position on cabbage leaf; **d,** suspended chrysalis—**a, c, d,** slightly enlarged; **b,** more enlarged.—(From Chittenden.)

Control.—More easily controlled early in the season. Dust the plants with (21.b) or spray with (9).

Maggot Leaf Miners. Small maggots, larvae of small, two-winged flies, feed between the skins of the leaves of various cruciferous plants, leaving small or large whitish blotches.

Control.—In gardens, cut off the infested portion of the leaves while the blotches are small. They are seldom seriously injurious in large fields.

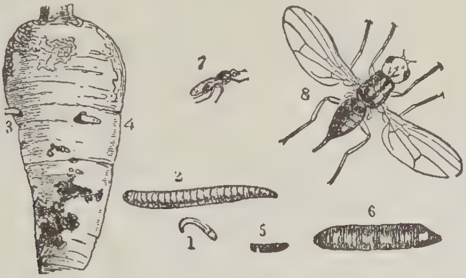
The Squash Bug, Anasa tristis.—This is a blackish-brown bug, yellowish below, three fourths of an inch long, with a sharp beak from the under side of the head. When numerous (rarely in this Province) it is very destructive. It feeds by sucking up the juice, and can therefore not be killed by stomach poisons.

Control.—Cut the rows of bronze eggs from the young plants and destroy them. Spray infested plants with (9) or (13) while the bugs are small; it is difficult to kill the full-grown bugs with sprays. Place pieces of shingle and the like near the plants to serve as hiding-places for the bugs; examine in the early morning and destroy the bugs hidden beneath. The plants may be protected by cheese-cloth covers as for the "striped-beetle." The bugs may be driven away for a short time with air-slaked lime. Invariably destroy completely the remains of all cucurbits as soon as the crop is off to check the breeding of pests for the next season.

The Melon Aphis, Aphis gossypii:— A dark-green plant-louse sucking the juice from melons and certain other crops. Rarely injurious in this Province.

Control.—Spray as soon as the tiny aphides are noticed with (13), taking care to cover the under sides of the leaves.

The Carrot Rust Fly, Psila rosae:—This minute, dark green, two-winged fly lays its eggs at the base of young carrots and celery. The slender, yellowish-white maggots work into the roots and leave rust-coloured tunnels winding through the pulp. In large carrots they often remain near the surface; in small carrots they attack the bottom of the root and often kill the plant. In celery the maggots seem usually to attack the thick part of the root. It has long been injurious in the Maritime Provinces, and in Eastern Quebec, and is now becoming common about Montreal Island.



The Carrot Rust-fly—1, 5, 7, natural size; 2, 6, 8 enlarged. (Curtis)

There are probably two generations each year. The larvae work in the stored carrots during the winter.

Control.—When this insect is expected, spray the carrots four or five times at intervals of a week or ten days with (13), making the first application about the time of thinning. Treat the earth in which carrots have been stored so as to kill all contained pupae; bury it deeply, spread it in a poultry yard, or empty it in a pond. Do not alternate carrots and celery on infested ground; plant either as far from infested ground as possible. The land will be clean of the fly in one season. Late sowing and rotation of crops are of use in avoiding injury.

The Asparagus Beetles, Criocerus asparagi, and C. 12-punctata:—the former of these is the most important insect enemy of the asparagus. The beetle is slender, blue-black in general color, with the thorax red, and the elytra dark-blue and lemon-yellow with a reddish border. It is slightly less than one-fourth of an inch in length. The adults hibernate under rubbish or in any shelter near the patches. The eggs are deposited endwise on the foliage in early spring in short rows. The eggs hatch in a week or less into grayish larvae, becoming yellowish with age, which feed upon the stems and foliage. They are full-grown in about two weeks and pupate in the soil, to re-appear as adults in a little over a week.

The second species is broader, and is reddish orange in colour, with twelve black spots on the wing covers.

The eggs are laid singly, and the larvae feed within the asparagus berries. The injury is in this case caused by the adults in feeding upon the edible shoots.

Control.—Allow chickens and ducks the run of the patch. Keep all asparagus cut down except the marketable shoots, and cut these every day, or few days; the eggs have then no time to hatch. Or some shoots may be allowed to grow to serve as "traps." These plants are sprayed with lead arsenate to kill the feeding beetles, and cut frequently and burned to destroy the eggs, others being allowed to grow to take their place.

Air-slaked lime shaken over the plants while they are wet with dew readily destroys the larvae feeding upon them.

Plants which are not being cut may be protected by spraying with lead-arsenate as often as required. On a hot sunny day the larvae may be killed by shaking them off on the hot earth.

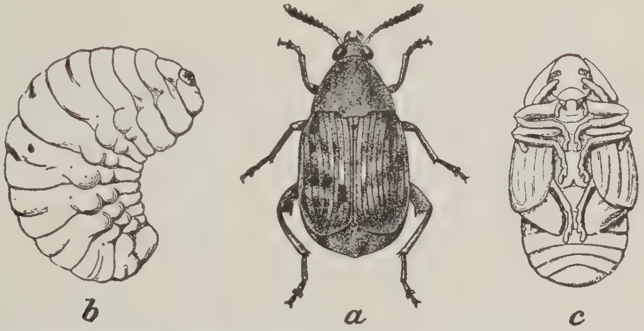
The Pea weevil, Bruchus pisorum:—This pest of seed-peas is a small beetle, one-fifth of an inch long, black in color, mottled with brown and white patches. The larvae feed within the growing peas. There is but one brood each season. Unlike the bean-weevil, this species does not breed in the dried seeds.

The eggs are laid on the pods; the larvae work through the pod and enter the growing seeds to complete their life-history within them. There is little evidence of their presence until they are near full-grown, when the cavity within which they lie is visible through the skin of the seed.

Control.—Gather the peas on the green side, before the adult beetles begin to leave them. Then fumigate the seed with carbon bi-sulphide. Place the seed in a tight box or cask and place the fluid on the top in a flat dish at the rate of an ounce or more to one hundred bushels of seeds. Cover tightly and leave for twenty-four hours. **The fumes are inflammable.**

Persuade neighboring pea-growers to cooperate, and the pest may be practically exterminated.

The Bean Weevil, Bruchus obtectus:—This pest of bean seed is not yet troublesome in Quebec, but has been introduced into one locality, and may soon occur in others.



The Bean Weevil (Bruchus obtectus): **a,** beetle; **b,** larva; **c,** pupa—greatly enlarged.—(Chittenden Yearbook, 1898, U. S. Dept. of Agric.)

The larvae feed within the seed; but unlike the pea-weevil, this pest breeds on for generation after generation in dried seeds. I have bred them continuously in dried beans for two years.

Control.—Gather the beans early and fumigate, as for the Pea weevil, as soon as possible.

The Pea Moth, Semasia nigricana:—The caterpillars of this moth live within the pods and feed upon the pea-seeds, gnawing holes in the sides. The caterpillars are half an inch long when full-grown, whitish and sparsely hairy. The portion of the pod near the injured seeds is filled with their excrement.

Control.—Sow early varieties, as early as possible. Plant as far as possible from an infested field of the previous year.

The Destructive Pea Aphis, Nectarophora destructor.—These are pale-green plant-lice with the legs darkened at the joints, and with long tubes behind. They appear suddenly in great numbers and kill the plants by sucking the juices.

Control.—On small patches and on sweet-peas, it can be controlled by spraying the infested vines with (9) or (13). In large fields, planted in rows thirty inches apart, the pest has been controlled by brushing the insects from the vines with brushes of twigs in front of a horse-cultivator. The insects are covered with earth and destroyed. This process needs to be repeated every three or four days for two weeks, the number of treatments depending upon the seriousness of the infestation. Very early planting is advisable. Invariably, all pea-vines should be burned as soon as possible after the crop is off.

Insect Pests of Cereals

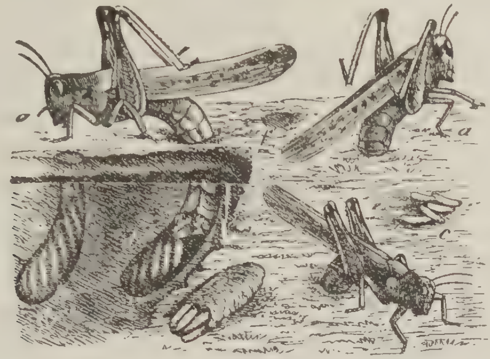
The Hessian Fly, Cecidomyia destructor.—Small, dark-coloured, two-winged flies lay their eggs in May and June, and others again in August, on the leaves of growing wheat, barley, and rye. The maggots when hatched work their way down to the bases of the leaves and become embedded in the tissue. The whitish maggots are found in the crown of winter wheat, and in the summer above the first or second joint within the sheath, sucking the juice of the stem from without. They weaken the stem and cause it to break. When the maggots become mature the skin hardens, and they appear somewhat like "flax-seeds." From these the adult flies emerge.

Control.—Have the land thoroughly prepared for the crop. If injury is likely to be great, sow strips of wheat in August along the margin of the future wheat-field. The eggs will be laid in this wheat and the strips should be plowed under about the middle of September. Defer planting the main crop until the last of September; by the time the plants appear, the flies will have vanished.

Burn dust and screening from threshing to destroy any flax-seeds contained. Deep plowing of the stubble as soon as the crop is off is of some advantage in burying the flax seeds. The application of a quick-acting fertilizer to an infested field is of much value. **Have the seed bed thoroughly well prepared, and sow, in the fall, as late as is safe.**

Grasshoppers or Locusts. These are very destructive in some seasons in grass and grain-fields. The eggs are laid in sod-land in the fall and hatch in early summer into the young, wingless hoppers. These feed upon the grass or grain throughout the season, becoming mature, and winged, late in the summer.

Control.—Fall-plowing is of some benefit in destroying the eggs. The simplest and most effective control is the use of **Criddle Mixture,** No. 8. The "hopper catcher" described in the Report of last year is effective on grass-lands.



Grass-hoppers laying their eggs.—(Copied).

The Clover-seed Midge, Cecidomyia leguminola:—These are small, pinkish maggots which destroy the seeds of the clover by feeding within the pod. A brood develops in each crop of clover seed.

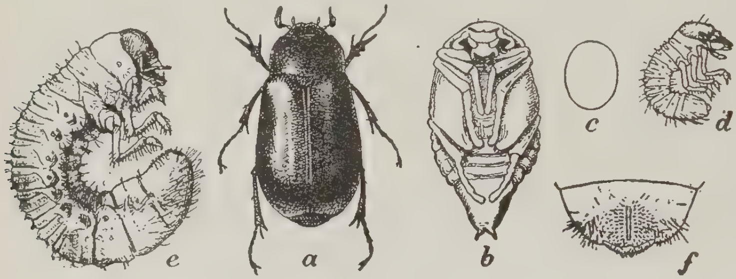
The Clover Root-borer.—(Riley).

Control.—Feed off or mow the first crop of clover about the middle of June. This destroys the brood of maggots, and the second crop of seed will usually be free from them.

The Clover-root Borer, Hylastinus obscurus:—Small, brown beetles and their white footless grubs, found boring into the crown and root, chiefly of the red and mammoth clovers. This insect is becoming numerous and widespread in this Province. The beetles are about one-twelfth of an inch long. The first crop is less injured.

Control.—When fields are infested, take but one crop of clover out of a rotation; plow shortly after the first crop is off (not deeply) and work roots to the surface with a spring-tooth cultivator. If this is done soon after cutting the larvae will be mostly killed by the heat of the sun.

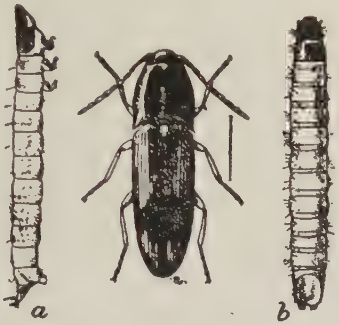
Flea-beetles. Small black or blue beetles are often found eating small holes in the leaves of turnips and other crops. When disturbed they jump readily, and are therefore called flea-beetles. It is difficult to poison them but they dislike Bordeaux mixture, and spraying the crop with this material effectively drives them away. Often an application of quick-acting fertilizer enables the plants to overcome the attack of the insects.



May Beetle; a. beetle; b. pupa; c. egg; d, e, larva (White Grub)—slightly enlarged. (Chittenden, Bull. 19. n.s., Div. of Ent., U.S. Dept. of Agr.

White-Grubs. White Grubs are the young of the common May-beetles, the large brown beetles so common in the spring. The grubs live for three years in the ground, and feed upon grass roots, or upon the roots of crops. They are often injurious to strawberries, as well as potatoes, corn, and many root-crops. As these grubs are usually common in grass lands it is seldom safe to plant strawberries, corn, or roots on freshly broken sod. A heavy top dressing of nitrate of soda or kainit just before planting is sometimes of benefit. Fall plowing turns the grubs to the surface and destroys many of them. When they injure strawberry plants kerosene emulsion, diluted 10 times, poured about the plants and washed in with one or two sprayings of water is effective. Hogs and chickens will devour great numbers of the grubs.

Wire-worms. These grubs have habits much like those of the white-grubs. They live for two years in the soil as grubs, and mature to slender, dark beetles called click-beetles. The grubs are slender, yellow or brown, hard-skinned "worms," with three pair of legs just behind the head. They, like the white grubs, attack the roots of many crops, although their natural home is in grassland. It is in freshly broken sod that these two pests do the damage. The remedies are much the same as for the white grubs, but these insects are even more difficult to control.



Wireworm: Larva and adult—all three times natural size. (Chittenden, Bul. 33, Bur. of Ent., U.S. Dept. of Agr.)

In sections where wire-worms are numerous, corn and other cereals, and vegetables should never be planted on freshly broken sod. Clover is not so seriously injured by them, and buckwheat seldom seriously, so that these, or other immune crops should follow grass before cereals or roots in infested districts. It is possible to poison many of the grubs when they are known to be present by sowing over the field corn which has been soaked in arsenic or strychnine and harrowing it in about ten days before the crop is planted. Fall plowing, early in the fall, destroys many of the pupae and young beetles.

Insects of the Household

Fleas. The flea commonly troublesome is one infesting cats and dogs, and if these animals are kept clean there is little likelihood of infestation. The eggs are laid, and the young develop, in dust of cracks and particularly in the rugs or mats upon which cats and dogs sleep.

Control.—Keep the sleeping places of the cat or dog clean. Rid the animals of the pests by rubbing well into the hair No. 21, pure and fresh. Hold the animal upon a large sheet of white paper or cloth. The fleas will be paralyzed and drop upon the cloth. After ten or fifteen minutes gather the pests and burn them. Pyrethrum powder is of use only when fresh, kept in tight jars. It is not poisonous to man or domestic animals.

Bed-bugs. Fumigate with Sulphur, see No. 26. Benzine, No. 3, is of some use, but cannot be depended upon. Thorough work with No. 26 will invariably be successful.

House Ants.—Find the nest, if possible, and destroy it with boiling water or by injecting into it a small amount of No. 6. Trap with a sponge moistened with sweetened water. When covered with the ants, drop the sponge in boiling water; squeeze out, moisten again in the sweetened water and replace. Repeat as often as needed.

Cockroaches. Discover their breeding-places, damp places about water pipes and the like; clean thoroughly and dust with No. 4. Fasten any holes about water-pipes or gas-pipes through which they may enter apartments. Scatter about the places where they congregate, early in the evening, No. 4, or No. 21 (pure), or any good roach powder, and sweep up and burn the insects in the morning.

House-flies or Typhoid-flies. These abominable pests breed in horse-manure and in other filthy places. They suck the juices on the filthiest materials within their reach. From these substances they carry disease-germs, typhoid, intestinal disorders of children, etc., directly to the food on the tables or in kitchens. Remember that every house-fly has bred within, and crawled over, some detestable filth. Therefore make every effort to keep them away from all food-materials and from the hands and lips of sleeping babies.

Control.—Allow no filth to remain in the light, in the immediate neighborhood of dwelling-houses. They breed chiefly in horse-manure. Keep all such material removed or placed in dark manure-sheds where the flies will not go to deposit eggs.

Keep the flies from houses by the careful use of screens, and fly-paper. Burning pyrethrum powder will drive them from a room. Those that fall to the floor should be swept up and burned.

Clothes Moths—See No. 6.

The Buffalo Carpet-beetle, Anthrenus scrophulariae.—These injurious beetles are about one-fourth of an inch in length, black, with whitish spots, and a red band along the middle of the back. The eggs are laid early in the season in carpets and the like. The curious, hairy larvae feed upon the fabrics and are responsible for the injury. They frequently follow cracks in the floor, feeding upon the carpet from the under side. These probably occur but rarely in Quebec, but when well established are very annoying pests.

Control.—When this pest is destructive it is better to use rugs that can be frequently removed and cleaned. Badly infested carpets should be removed, thoroughly cleaned and beaten, and sprayed with benzine on the infested parts. All cracks in the floor should be soaked with benzine,(have no exposed lights near the fumes), and before replacing the carpets or rugs fill all cracks in the floor with prepared "crack-filler" or putty, or the like. The larvae, if not very numerous, may be killed without removing the carpets by laying two or three thicknesses of wet cloth over the infested parts and ironing with flat-irons. The steam thus generated is quite effective. Spray infested furniture with benzine. Treat garments as recommended for the Clothes-moths.

AN OUTLINE OF THE MOST VALUABLE INSECTICIDES

1. Alkaline Wash for Borers:—

Washing soda—saturated solution.
Soft soap—to make a thick paste with the soda solution.
Crude carbolic acid—1 pt. to 10 gals. of the wash.
Paris green—½ lb. to 10 gals. of the wash.

Apply to the trunks and larger branches not later than the first of June. Used to prevent egg-laying of the Apple-tree borers.

1. Arsenate of Lead (See Lead Arsenate).

2. Arsenite of Lime and Soda:—This is a cheap and effective insecticide for all purposes for which Paris green is used. It is made in several ways; the following formula by Professor Stewart is one of the best.

(Stock Solution)—White arsenic—2 pounds.
Sal soda (crystals)—2 pounds.
Fresh quick lime—3 to 4 pounds.

Mix the arsenic and soda in the water and boil for 15 minutes, or until the arsenic is dissolved. Then add the lime and allow it to slake in the still boiling liquid. Remove and dilute the mixture to two gallons. One quart of this mixture, when thoroughly stirred, is added to a barrel of water for spraying

It can be made in larger quantities and stored for the season; but should be kept tightly covered and should be labelled distinctly "Poison."

All the arsenic insecticides are strong poisons, and should be kept labelled, under such conditions that mistakes could not take place.

Use this insecticide with caution. Many complain that it burns the foliage.

3. Benzine:—Useful against some insects. It is sprayed into cracks and crevices for bed-bugs; and is injected into borings of grubs in fruit trees with good effect.

4. Borax.—Powdered borax mixed with sweetened chocolate scattered in the evening about the haunts of cockroaches is an efficient control.

Bordeaux Mixture. (See under Paris green.)

5. Carbolic Acid Emulsion:—This material is of service in the control of root-feeding larvae. It kills by contact, and must therefore be poured about the infested roots, and while the larvae are young. When applied shortly after cabbages are set it seems often to prevent egg-laying; but must be repeated once a week until the plants are well started. A tablespoonful, or more, is poured about the base of each plant.

1 pound hard soap shaved fine.
1 pint crude carbolic acid.
1 gallon boiling water.

Dissolve the soap in the water; add the acid and churn or beat until a thick emulsion is produced. This is the stock solution, and must be diluted with from 20 to 40 parts of water for use.

If 90% carbolic acid is used one part of the stock to 40 or 50 of water should be effective; but with the weaker acid, 50% or so, less water should be used, 1 part of the stock to 20 parts of water. (The tarred paper disks, for controlling the cabbage maggot, are much more effective). When applied several times at intervals of one week, beginning as soon as the plants are well up, this emulsion will ensure clean radishes; and is used, with varying degrees of success, against the onion maggot.

6. Carbon Bi-Sulphide:—For insects in peas, beans and grain.

One pint or pound for each 100 bushels of grain or 1000 cubic feet of space. The liquid is placed in shallow dishes upon the material to be fumigated, or on shelves in the rooms.

To control an attack of clothes moths.—Thoroughly clean the infested part of the house. Shake and brush infested furs, feathers and woollens well and leave out of doors for several hours. Then fumigate them in air-tight boxes or trunks, with carbon bi-sulphide. In a box, trunk size, nearly filled with loosely placed clothing, etc., put a tablespoonful or so of the liquid in a saucer on top of the material. Close the lid tightly and leave for 24 hours or longer. The box should be as nearly air-tight as possible. The fumes evaporate completely and leave no traces whatever. Later the clothes should be taken from the box, thoroughly brushed and shaken, and sealed in tight boxes with plenty of moth balls to prevent reinfestation. The boxes may be sealed with paper pasted about the edges. The fumes are inflammable and all fire must be kept away.

7. Creolin:—An excellent insecticide for lice on domestic animals. It is used as a five per cent. solution in water. Mix thoroughly in the water and apply as a spray or with a cloth or sponge. Also a good antiseptic.

8. Criddle-Mixture:—For control of grass-hoppers. Mix thoroughly one part (by measure) of Paris green, two parts of salt (dissolved in water), and one hundred parts of fresh horse droppings. The mixed material should be thoroughly moist, but not sloppy. Add sufficient water.

Scatter the mixture with a flat stick about the edges of the grain fields and on badly infested grass-lands. It is most conveniently made in half barrel lots; and is most effective in hot sunny weather. Cheap and very effective.

9. **Fish-Oil Soap:**—This is an excellent application for plant lice and as a general contact insecticide, but is rather expensive.

For green plant-lice, or young scales or leaf-hoppers, use one pound of soap in seven gallons of water. For black or brown plant-lice use one pound in five gallons of water. It dissolves more easily in hot water.

As a winter application for scale insects it is sometimes used at the rate of two pounds in one gallon of water, to be applied in early spring before the buds start. This strength will destroy leaves and opening buds.

Tobacco decoction is often added to the dilute sprays.

10. **Green Arsenoid:**—An arsenic compound containing no acetic acid. It is less likely to burn the foliage than Paris green, and being finer remains in suspension longer. It is cheaper than Paris green and accordingly is to be preferred for general use. It is used in the same way as Paris green.

Green arsenoid should not be confounded with Scheele Green, an arsenic compound worthless as an insecticide on account of its large content of soluble arsenic.

11. **Hellebore:**—This may be obtained from any druggist; and when dusted on infested plants while they are wet will control currant worms and cabbage worms quite effectively. It may be used pure, or mixed with five parts of dry flour or air-slaked lime. It is commonly used as a spray for the same purpose at the rate of one ounce of powder steeped in two gallons of water. It is hardly poisonous.

For use against maggots of cabbage, onions, and radishes, one ounce or more of the powder is steeped in a gallon of water, and the mixture poured or sprayed about the roots of the plants. Several applications must be made at intervals of a week, beginning about the third day after setting, or shortly after the plants are above the ground.

12. **Hot Water:**—Hot water sprayed on cabbages will effectively control cabbage-worms on a small patch. Lice on house plants are quickly destroyed by dipping the plants, foliage only, in a pail of water hot as the hand will bear.

13. **Kerosene Emulsion:**—

Soap (fish-oil or other)—½ lb.
Kerosene or crude oil—2 gallons.
Hot water (soft)—1 gallon.

Dissolve the soap in the hot water, add the oil, and churn violently until a thick creamy emulsion is produced. This gives the stock solution, which will harden on cooling and may be kept for some time. For use it must be diluted with nine or more parts of water. Warm water is better. Three gallons of stock solution gives thirty gallons of spray.

14. Shutt's Flour-Kerosene:—

Flour—8 oz.
Kerosene—1 qt.
Water—2 gallons.

Scald the flour and mix thoroughly with the kerosene. Add the water and churn violently until a creamy emulsion is produced. This is ready for use. The churning is best done with the pump by driving the liquid back into the barrel. Must be kept mixed while spraying is being done.

15. Lead Arsenate, Arsenate of lead, "disparene."—This insecticide is more nearly insoluble than Paris green and is therefore less likely to burn the foliage. It contains less arsenic than Paris green and has to be used in larger amounts, usually 3 to 6 pounds in a hundred gallons of water; but it is finer and adheres so much longer to the foliage that it is quite as cheap in the end. It can be safely used on most vegetable crops as strong as 12 pounds to the 100 gallons and is therefore particularly useful when very strong applications are to be made. It is to be preferred on smooth leaves like those of the cabbage.

Several brands of lead arsenate can be obtained from dealers in insecticides and the better brands contain about 20% of arsenic oxide. It comes in the form of a paste and the required amount should be worked up in a little water in a pail before being added to the water in the spray pump.

For spraying fruit trees one pound and a half to two pounds to the barrel of water is the usual strength. For controlling the potato beetle, three pounds to the barrel are used. No lime is needed with the standard brands.

In purchasing lead arsenate secure a brand like the "Electro" with about 20% arsenic oxide. A few of the poorer brands contain only one-half as much oxide while the cost is about the same.

This insecticide can be made on the farm in any quantity, but it is nearly as cheap to buy the prepared paste and saves much trouble.

In spraying fruit trees the application must be thorough and with all possible force.

When applying lead arsenate for the plum curculio use four pounds to the barrel for the first application and three pounds to the barrel for the second.

The first just before the buds open, the second just after the blossoms fall, and a third is often profitable two weeks later, 3 lbs. to the barrel.

16. **Lime:**—Air-slaked lime as a fine dust is of value in the control of the pear slug, and is used as a diluent in the application of dry Paris green.

Thick lime-wash poured along the rows shortly after the plants are up is of effect in warding off attacks of onion maggots. The cracks in the surface about the plants must be kept filled with the wash. A band of lime about a plant bed will keep it free from slugs and snails.

17. **Lime Wash for Oyster-Shell Scale:**—

Unslaked lime—1 to 2 lbs.
Water—1 gallon.

Slake the lime with part of the water and add the remainder. Strain through coarse sacking before using.

Apply in the fall, giving a second coat as soon as the first is dry.

18. **Lime Sulphur Wash:**—We hear much now-a-days about lime-sulphur wash as an insecticide and as a fungicide. As a fungicide it is undoubtedly of value and is rapidly replacing Bordeaux mixture. As an insecticide, lime sulphur is a standard remedy against San Jose scale and blister mite; and is also, in a measure, effective against hibernating stages of various insects on trees. The commercial brands are sold in concentrated form and must be diluted for use. A home-made concentrated lime-sulphur has recently been developed which costs considerably less than the commercial brands, when made in quantity, and can be made to give excellent results. For spraying small orchards the commercial brand will probably be preferred. But when a large amount of lime sulphur is to be used it will pay to make the "home-made concentrate," directions for the preparartion and dilution of which will be found in Bul. 92, Penn. Experimental Station, State College Pa.; Bul. 320, N.Y. Experiment Station, Geneva, N.Y., and Farmers' Advocate March 9, 1911, by Mr. L. Caesar.

The home-made concentrate will doubtless be still further improved upon during the present season: and orchardists with much spraying to prepare for will do well to combine in its production another season.

Directions for making the old-fashioned home-boiled lime-sulphur are given below. Such lime-sulphur can be used only on dormant trees, and must be applied as made, or reheated before using. If much is needed it is cheaper and easier to make the home-made concentrate.

Lime Sulphur Wash:—(Boiled) for dormant trees only.

Best finishing lime (fresh)—20 lbs.
Sulphur, flour or flowers—14 lbs.
Water—40 gals.

Start the lime slaking; add the sulphur and sufficient water to cover, stirring constantly; and boil for one hour in a kettle over a fire, or in an open barrel with steam. Strain into the pump and dilute to 40 gallons. This should be used immediately; if allowed to stand over-night it must be heated before using.

Lime Sulphur Wash:—(Self-cooked) for dormant trees.

Fresh lime (Best quality)—30 lbs.
Sulphur—17 lbs.
Water—40 gals.

Make the sulphur into a paste with 2 gallons of water. Place the lime in a large barrel and pour over it 10 or 12 gallons of boiling water, and add the sulphur paste. Cover with thick sacking and leave to cook for half an hour, stirring occasionally. After 30 minutes cooking add 8 gallons warm water, strain into the spray pump and use immediately. The boiled wash is more eliable.

The prepared lime sulphur wash sold by dealers in insecticides costs more than the home-made solution, but is otherwise quite as satisfactory. It should be diluted with 8 or 9 parts of water for spraying dormant trees. The hydrometer reading of the dilute spray should be 4.4 or 4.5 degrees Beaumé or about 1.03 Sp. G. This strength cannot be used on trees in foliage. An annual spraying of lime sulphur wash, early in the spring before the buds start, is to be recommended for apple orchards.

If lime-sulphur is used as a summer fungicide the concentrated form must be diluted with from 25 to 40 parts of water. For this dilution a specific gravity hydrometer is convenient. Take the reading of the concentrate. Divide the decimal by the decimal of the spray desired, and the quotient will be the number of dilutions necessary. For spraying apple-trees in foliage a concentration of 1.01 S.G. is used.

18a. Poisoned Lime Sulphur.—Do not use Paris green for poisoning lime sulphur. Use a good grade of lead arsenate. The poison is added to the lime sulphur at the same rate as when added to water.

19. London Purple.—When obtainable this is nearly as valuable as Paris green. It is used for the same purposes and at the same rate, and is a little cheaper. As it contains a large and variable amount of soluable arsenic it should always have added from two to four pounds of quick-lime for each pound of the poison.

20. Naptheline, (Moth-balls), Camphor.—These substances are of use in warding off insect attack on clothing and collections, but do not kill insects already present.

21. Pyrethrum Powder (Useless after being kept in open receptacles).

a. Used as a spray:—one ounce of powder in three gallons of water.

b. Used as a dry application:—one part of powder carefully mixed with four parts of flour and kept in a tight can for one day. Dust on infested plants with a powder gun or from a bag of coarse sacking; or may be used pure.

22. Paris Green.—Paris green, the most widely used of the stomach poisons, is a compound of arsenious oxide, copper oxide, and acetic acid. It is soluable in ammonia and almost insoluable in water. It should leave no sediment when added to ammonia and should not contain over 3½ per cent of water soluable material.

It is used as an insecticide both dry and as a spray. Used as a spray it should always be mixed with twice its weight of freshly slaked lime; the soluble portion, which might otherwise burn the foliage, is then united with the lime to form an insoluble arsenite of lime. When Paris green is added to Bordeaux Mixture the excess of lime in the latter renders the addition of extra lime unnecessary.

The Paris green particles are heavy, and readily sink in water so that the spray mixture must be kept constantly stirred while the spraying is in process. Every pump should contain an effective "Mixer."

The regular formula is:—

Paris green—1 pound (for fruit insects); 2lbs.(for vegetable insects).
Best lime (fresh)— 2 to 4 pounds.
Water—160 gallons.

Preparation.—The Paris green is made into a paste with water and stirred into the lime-and-water mixture. Or the Paris green may be added gradually to the lime as the latter is slaking, and this stirred into the rest of the water.

On peach and other very tender foliage it is safer to use arsenate of lead.

Paris green is often used on potatoes at the rate of 1 pound to forty gallons of water or even stronger, but one pound to sixty gallons of water or Bordeaux mixture is quite effective if the spraying is thoroughly done.

For potato beetles use one pound of Paris green to 60 gallons of water; for canker worm—one pound to 75 or 100 gallons. Always add twice as much lime as Paris green.

When used as a dry application for the Potato beetle, one pound of Paris green is thoroughly mixed with fifty pounds of cheap flour, or air-slaked lime, or fine sifted land-plaster. It should be applied with a powder gun or from a bag of coarse sacking while the plants are wet with dew or from a shower.

On very small potato plants the early appearing beetles may be controlled in a measure by applying Paris green with lime, or flour, or plaster, at the rate of one pound of Paris green to fifteen of the diluent. There is so little leaf surface at this time that the ordinary spray is nearly useless if the beetles are in great numbers. Hand-picking is then practical.

When Bordeaux Mixture is to be sprayed on the same crops, the Paris green and Bordeaux are mixed and the expense of application lessened.

22a. The formula for this mixture, **Poisoned Bordeaux,** is:—

Bluestone, CuSo4—4 pounds..........4 }
Quick lime, best quality—4 pounds....6 }also commonly used.
Water—40 gallons..................50 }
Paris green—4-8 oz.

Preparation.—Dissolve the Bluestone in one-half the water, 20 gals., by suspending it just below the surface in a bag of coarse sacking. Slake the lime slowly and add water to make 20 gallons. Add the Paris green to the lime while slaking. Pour the two solutions together into the spray pump.

On peach, cherry and plum it is safer to use three pounds of bluestone instead of four, in the formula above.

Poisoned Bordeaux in small quantities.
Bluestone—4 level tablespoonfuls.
Lime—4 level tablespoonfuls.
Paris green—1 level teaspoonful.
Water—1 pail (2 gallons).

Paris green is rapidly giving place to lead arsenate and, according to some authorities, should be superseded by Green Arsenoid, a cheaper and equally effective insecticide.

Poisoned Bordeaux, (see under Paris green).

23. Poisoned Bran Mash.—For cut-worms, etc. Mix thoroughly from one half pound to one pound of Paris green in twenty-five pounds of bran moistened with sweetened water.

This should be placed or scattered at sundown about the bases of the plants to be protected. When cut-worms are feared the mash should be scattered broadcast over the field a few days before the plants are up. One application should be effective.

Weeds or clover sprayed with strong Paris green Mixture or lead arsenate may be cut and used in the same way with good effect. Always apply the bran mash after the heat of the day is over.

24. Salt, Nitrate of Soda, Kainit, etc.—Salt is of some use against root-maggots. Some report that strong brine poured about the roots destroys root-maggots in cabbages, raddishes and carrots, without injuring the plants. Should be used with caution.

Nitrate of soda and kainit are valuable fertilizers, and are of some use on light soils in the control of white-grubs and wire-worms, when applied in large amount.

Scheele's Green.—(See Green Arsenoid).

25. Soap Solution.—One pound of washing-soap dissolved in 4 to 6 gallons of water. For plant lice on house plants or in gardens.

26. Sulphur.—Sulphur, as lime-sulphur wash, is the most valuable scalicide known. It is a specific against mites of all kinds, and will destroy fleas and hen-lice as effectively as Pyrethrum powder.

For destroying mites on foliage, flowers of sulphur in small quantity is added to water or strong soap suds or to kerosene emulsion.

Sulphur is a valuable fumigant for destroying bed-bugs. The clothing in the infested rooms should be opened, all drawers of furniture opened, beds separated, etc.; and then the windows, and all doors but one securely sealed. The sulphur is then burned in the centre of the room. For a bed-room of ordinary size use a double handful heaped, of flowers of sulphur. This is put in an iron pan placed on an oil-stove or other apparatus for generating constant heat. The whole should be placed in a large iron pan or on a sheet of zinc. The oil stove is then lit and the last door sealed from the outside. Fumigated in this way all the bugs in a room may be certainly destroyed. As some eggs may escape, however, a second fumigation should be made about a week and a half later.

27. Tobacco Decoction:—

Refuse tobacco—2 lbs.
Water—5 gallons.

Boil for a half-hour in part of the water; keep covered till cool; add water to make 5 gallons and apply undiluted. An ounce of pyrethrum added to the hot liqiud increases its value. For plant-lice and as a contact insecticide generally. Tobacco stems, refuse, and extracts are used with effect against plant-lice in greenhouses as fumigants.

SPRAY CALENDAR

Plant	1st Application	2nd Application	3rd Application	Notes
Apple.	No. 1. (see below). Shortly before buds open. For hibernating insects and fungi.	No. 2a (or No. 3a). Just before blossom-buds open. For scab, canker-worm, curculio, etc., (use lead arsenate for curculio), 4 lbs. per barrel in this spray.)	No. 2a (or No. 3a). IMMEDIATELY after blossom petals have fallen ; before closing of calyx-cup. For codling-worm, curculio, scab, etc.	A fourth spray of No. 3 or No. 3a. 2 weeks later if scab threatens. Oyster-shell is controlled by lime-wash applied late in fall, two coats, second soon as first is dry.
	Gather promptly and destroy completely, feed to stock, **all fallen wormy fruit.** This checks the **curculio** and is the only control for the **apple-maggot.** Watch for borers in the bark in the early fall, and remove with a sharp knife. Watch for aphis in spring and if they appear in numbers, spray with No. 8 or No. 10, immediately, before the leaves begin to curl.			
Cherry	No. 1. Before the buds begin to open.	No. 2a (or No. 3a). When fruit is fairly set.	No. 2a (or No. 3a). About two weeks later, and repeat if rot threatens.	Watch for aphis ; if they appear spray before leaves curl with No. 8 or No. 10. Watch for black knot ; cut out completely and burn as soon as found. For slug, use lead arsenate or air-slaked lime as required.
Plum.	As for cherry.	As for cherry.	As for cherry.	Be careful to remove black knot as soon as it appears. Burn all mummied plums in autumn. Completely destroy all wormy fruit as soon as possible. For slugs, as with cherry.
Pear.	No. 1. Before leaf-buds burst.	No. 2a (or No. 3a). Just before blossoms open.	No. 3 (or No. 3a). Just after blossom petals have fallen.	Wet weather may necessitate a 4th application for scab, 2 weeks later. For slugs as with cherry and plum, cut out all blight as soon as noticed; cut well below diseased area.
Grape.	No. 3. When 3rd leaf is appearing.	No. 3. Just before blossoms open.	No. 3. As soon as fruit is set.	Two or three additional sprays may be needed at intervals of 10-15 days, if wet weather obtains. For leaf-hopper (often called 'thrip') spray No. 8 or No. 10, before the insects obtain their wings. Destroy all wormy and mummied grapes and prunings by burning.
Currant	No. 1. Before buds open.	Spray with No. 2a, or No. 3a, when "worms" appear ; use hellebore instead while fruit is ripening. Watch for aphis, and spray with No. 2, or No. 10 before leaves curl. Cut out and burn any dying canes (in May) as soon as noticed. (cane-borers).		
*Gooseberry	No. 1. Before buds open.	No. 2a Just before blossoms open.	No. 2a Soon as fruit is set.	Usually well to give a 4th application of No. 2a 10 days after 3rd. For "worms" as with currant.
Raspberry and Blackberry.	No. 3. Before leaf-buds open.	No. 3. 2 weeks later.	If anthracnose is severe, prune out old canes and diseased new ones soon as fruit is picked. Remove and burn diseased plants as soon as rust appears. In setting new plants avoid all with "galls" on root or crown. For leaf-miners, burn infested leaves. For saw-fly larvae, use lead arsenate.	
Strawberry.	Use land broken for more than three years, if white grub is common. Use only healthy plants for setting. If leaf-spot is troublesome keep plants covered with Bordeaux throughout first season ; second season spray with Bordeaux before blooming, and after picking mow and burn. Take but two crops. Dig out white grubs soon as injury is noticed.			
Potato.	To prevent scab soak tubers for 2 hours in formalin, one pint commercial formalin in 30 gals. water. Keep plants covered with No. 3, sprays 2 weeks apart, from the time they are six inches high; add lead arsenate, or Paris green, as required for checking the beetles. It frequently pays to hand-pick the beetles until plants are large enough to carry considerable poison. Bordeaux wards off flea-beetles.			
Tomato.	Spray plants in seed bed with Bordeaux, and later with same as required.			
Asparagus.	Allow no plants to mature during cutting season. Give chickens the run of the plantation. Spray with lead arsenate as soon as cutting is over, twice if needed to keep down beetles. When growth is over for the season cut and burn the plants.			
Cabbage and Cauliflower.	For root-maggots, place tarred-felt discs (3 in diam.) about plants when set ; or use No. 9a, driven or poured about roots, at intervals of a week till second week in July, beginning three days after setting. For caterpillars, spray with lead arsenate as required. If preferred use No. 9a or b, instead, after heads are well formed. For aphis spray with No. 8 as required. DESTROY REMAINS OF CROP IN THE FALL.			
Carrot.	For rust-fly, spray with No. 10, first about the time of thinning, and repeat at intervals of ten days until five sprays have been given. Treat earth which has bedded infested carrots during the winter (heat or submerge in water).			

INSECTICIDES AND FUNGICIDES.

No. 1. Lime-sulphur wash, commercial, spring strength. As obtained from dealers, diluted one part to nine parts water. Self boiled wash may be used instead.

No. 2. Lime-sulphur wash, commercial, summer strength. As obtained from dealers diluted one part to 30-40 parts water. Home boiled concentrated takes the place of the commercial, but is only two-thirds as strong.

No. 2a. Lime-sulphur with a poison, lead arsenate, 2 lbs. to 40 gals.; for potatoes 3 lbs. to 40 gals.; for curculio, 3-4 lbs. to 40 gals.

No. 3. Bordeaux Mixture :—
Copper sulphate............ 4 pounds, 4 }
Quick lime (best grade)..... 4 " 6 } also commonly used.
Water......................40 gallons, 50 }

Preparation :—Dissolve the copper sulphate in one-half the water, by suspending in a bag just below surface. Slake the lime slowly and add water to make 20 gallons. Pour the lime mixture into the sulphate. Never mix concentrated solutions. If the prepared Bordeaux turns reddish with addition of a little ferocyanide of potassium add more lime.

No. 3a. Poisoned Bordeaux Mixture.—No. 3 plus a poison, lead arsenate, or Paris green. Lead arsenate, 2 lbs. to the barrel of Bordeaux, except for potato beetles and curculio where 3 lbs. to the barrel are used. It can be used much stronger, as for cucumber-beetles, without burning. Paris green, one-quarter pound to the barrel for fruit-tree insects, one-half pound per barrel for vegetable insects. For potato-beetles use at rate of one pound to 40-60 gallons and apply thoroughly.

No. 4. Lead Arsenate.—2 pounds to the barrel ; for potato-beetles and curculio, 3 lbs. per barrel. It can be used much stronger without burning.

No. 5. Paris Green :—
¼ — ½ pound Paris green.
1 — 2 pounds quick lime.
40 gallons water.
For potato-beetles use 1 pound per barrel.

No. 6. Poisoned Bran Mash. One pound Paris green thoroughly mixed in 50 pounds of bran moistened with sweetened water. Scatter about plants in evening to protect from cutworms.

No. 7. Criddle-Mixture.—For control of grass-hoppers. Mix thoroughly one part (by measure) of Paris green, two parts of salt (dissolved in water), and one hundred parts of fresh horse droppings. The mixed material should be thoroughly moist, but not sloppy. Add sufficient water.

Scatter the mixture with a flat stick about the edges of the grain fields and on badly infested grass-lands. It is most conveniently made in half barrel lots ; and is most effective in hot sunny weather. Cheap and very effective.

No. 8. Fish-oil Soap, (whale-oil Soap).—Good contact insecticide, for aphis, leaf-hoppers, etc.—
For green aphis—1 lb. soap in 7 gallons hot water.
For black aphis—1 lb. soap in 5 gallons hot water.
Improved by addition of tobacco decoction.

No. 9. Hellebore.—(a) 1 oz. steeped in 2 gallons water ; or (b) used dry, pure, or mixed with five parts of cheap, dry flour.

No. 10. Kerosene Emulsion.—
Soap (fish-oil or other) ½ lb.
Kerosene or crude oil 2 gallons.
Hot water (soft) 1 gallon.

Dissolve the soap in the hot water, add the oil, and churn violently until a thick creamy emulsion is produced. This gives the stock solution, which will harden on cooling, and may be kept for some time. For use it must be diluted with nine or more parts of water. Warm water is better. Three gallons of stock solution gives thirty gallons of spray.

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* See article in this issue on Gooseberry Mildew, by Mr. Williams.

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FOURTH ANNUAL REPORT

OF THE

Quebec Society for the Protection of Plants from Insects and Fungous Diseases

✻

1911-1912

✻

PRINTED BY ORDER OF THE LEGISLATURE

QUEBEC
LOUIS V. FILTEAU, KING'S PRINTER
1912

FOURTH ANNUAL REPORT

# of the

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

from

INSECTS AND FUNGOUS DISEASES

1911-1912

To the Honourable J. E. Caron, M.P.P.,
Minister of Agriculture,
Quebec.

Sir :—

I have the honour to present herewith the Fourth Annual Report of the Quebec Society for the Protection of Plants from Insects and Fungous Diseases, containing the proceedings of the Summer and Winter meetings of the Society, which were held at the Agricultural Institute at La Trappe, and at Macdonald College, Ste. Anne de Bellevue, Que., on the 26th and 27th of September, 1911, and the 27th of March, 1912, respectively.

Included are the papers that were read, and the reports of the officers of the Society.

I have the honour to be,
Sir,
Your obedient servant,

J. M. SWAINE,
Secretary-Treasurer.

Macdonald College,
Que., 1912.

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

OFFICERS FOR 1911-1912

President—William Lochhead, B.A., M. Sc., Professor of Biology, Macdonald College, Que.

Vice-President—Mr. Auguste Dupuis, Director of Experimental Fruit Stations, Village des Aulnaies, Que.

Secretary-Treasurer—J. M. Swaine, M.Sc.A., Assistant Entomologist for Forest Insects, Ottawa, Ont.

Curator and Librarian—J. M. Swaine, M.Sc.A., Ottawa, Ont.

Directors—Rev. Dr. Thos. Fyles, Hull, Que.; Rev. Father Leopold, La Trappe, Que.; Rev. Brother Victorin, Longueuil, Que.; A. F. Winn, Esq., Montreal, Que.; Prof. L. S. Klinck, Macdonald College, Que.

Auditors—Prof. John Brittain, Macdonald College, Que.; W. P. Fraser, Lecturer in Biology, Macdonald College, Que.

MEMBERS OF THE QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

Arkell, H. S.	Dept. Agr., Ottawa
Brittain, Dr. John	Macdonald College
Blair, Prof. Saxby	Macdonald College
Bates, F. W.	Macdonald College
Barton, H.	Macdonald College
Benjamin, Rev. Brother	La Trappe, Que.
Brittain, Wm.	Macdonald College
Browne, F. S.	Macdonald College
Bryce, P. I.	Macdonald College
Buck, F. E.	C. E. F., Ottawa
Campbell, Rev. Dr. Robt.	Montreal
Chagnon, G.	Montreal
Chapais, J. C.	St. Denis-en-bas, Que.
Cloutier, M.	La Trappe, Que.
Cutler, G. H.	Macdonald College
Dash, J. S.	Macdonald College
Davis, M. B.	Yarmouth, N.S.
Dreher, W. C.	Macdonald College
Ducharme, Rev. Geo.	Rigaud, Que.
Duporte, E. M.	Macdonald College
Dupuis, Auguste	Village des Aulnaies, Que.
Durost, H. B.	Macdonald College
Delaire, O. E.	St. Hyacinthe, Que.
Dasen, H.	Macdonald College
Eastham, J. W.	C. E. F., Ottawa
Edouard, Rev. Brother	La Trappe, Que.
Emilien, Rev. Father	La Trappe, Que.
Flewelling, D. B.	Macdonald College
Fraser, W. P.	Macdonald College
Fyles, Rev. Dr. Thos. W.	Hull, Que.
Gibson, Arthur	C. E. F., Ottawa
Grignon, Dr. W.	St. Adele, Que.
Güssow, H. T.	C. E. F., Ottawa
Hall, Landon	Cowansville, Que.
Hammond, H. S.	Macdonald College
Harrison, Dr. F. C.	Macdonald College
Hewitt, Dr. C. G.	C. E. F., Ottawa

Honore, Rev. Father	La Trappe, Que.
Huard, Rev. Abbe	Laval University, Quebec City
Jack, Norman E	Chateauguay Basin, Que.
Klinck, Prof. L. S	Macdonald College
Leopold, Rev. Father	La Trappe, Que.
Liguori, Rev. Brother	La Trappe, Que.
Lyman, Henry H	Montreal
Lochhead, Prof. Wm	Macdonald College
MacClement, Dr. W. T	Queen's University, Kingston, Ont.
MacFarlane, J. R. N	Macdonald College
Moore, G. A	Montreal
Nantel, G. A	Montreal
Nagant, H	Quebec City
Newman, C. P	Lachine Locks, Que.
Parent, L. V	Grande Ligne, Que.
Raymond, Mr	La Trappe Que.
Reid, Peter	Chateauguay Basin, Que.
Reid, T	Macdonald College
Robinson, J. M	Macdonald College
Simard, Mr	La Trappe, Que.
Straight, E. M	Macdonald College
Swaine, J. M	C. E. F., Ottawa
Summerby, R	Beech Ridge, Que.
Tourchot, A. L	St. Hyacinthe, Que.
Vanderleck, J	Macdonald College
Victorin, Rev. Brother	Longueuil, Que.
Weir, Douglas	Macdonald College
Winn, A. F	Montreal
Wood, G. W	Genoa, Que.

Honorary Member :

James W. Robertson, Esq., LL.D., C.M.G.

FINANCIAL STATEMENT

of the

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS FROM INSECTS AND FUNGOUS DISEASES

1912

RECEIPTS

Brought forward	$266.92
Interest on deposit to December 31, 1911	3.42
Provincial Government cheque for 1911	250.00
	$520.34

DISBURSEMENTS

Publishing of Report (English and French) for 1909-1910	$ 80.00
Delegates to the Meetings of the Ontario Entomological Society	57.20
Members' Expenses to the Summer Meeting at La Trappe	33.75
Expenditure to assist preparation of Quebec List of Insects	14.56
Stamps and incidental expenses	8.46
Secretary's stipend paid Mr. Weir for services during previous two years	75.00
Secretary's stipend to Mr. Swaine	50.00
	$318.97
Balance, cash on hand, March 27, 1912	201.37
	$520.34

J. M. SWAINE, Treasurer.
W. LOCHHEAD, President

Auditors :

REV. FATHER LEOPOLD
DR. JOHN BRITTAIN

FOURTH ANNUAL REPORT

# of the

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

REPORT OF THE THIRD SUMMER OUTING

The Third Summer Meeting of the Quebec Society for the Protection of Plants was held at La Trappe, Que., on September 26th-27th, 1911.

In addition to the members resident at La Trappe, there were present twenty-seven members of the Staff and Student Body of Macdonald College.

After lunch the large number of members present were divided into three parties, under the leadership of Professor Lochhead, Mr. Swaine and Mr. Brittain, respectively, for the purpose of collecting and studying the injurious insects and fungi of the neighborhood.

Many of the Students of the Institute took part in the excursions, and in the meeting which followed.

In the evening a meeting was held in one of the lecture rooms of the Institute, at which several addresses were given, and the collections of the afternoon discussed.

Addresses were given by Professor Lochhead, the Rev. Father Edouard, the Rev. Father Leopold, the Rev. Brother Liguori, Professor Marsan, Mr. Swaine, Mr. Brittain, Professor Dorgans and Mr. Clouthier. Several of the addresses were followed by very interesting discussions.

Mr. Dreher and Mr. Parent, of Macdonald College, acted as interpreters.

REPORT OF THE WINTER MEETING

The Fourth Annual Winter Meeting of the Quebec Society for the Protection of Plants was held in the Biology Building of Macdonald College, Que., on Wednesday, March 27th, 1912.

THE BUSINESS MEETING was called by the President, Professor Lochhead, at 2 p.m.

The minutes of the last meeting were read and approved.

Mr. A. F. Winn reported progress on the Quebec List of Insects, and presented the manuscript of the List of the Lepidoptera of Quebec, prepared by him, and ready for publication. It was decided unanimously that the Society recommend to the Government the publication of Mr. Winn's List of Quebec Lepidoptera as an Appendix to the Report for 1912.

The President suggested two lines along which the Society might do useful work. These were the preparation of a revision of Provancher's Flore Canadienne (in French), and the preparation of economic collections of insects, with explanatory pamphlets, to be sent to normal schools and other important schools of the Province. After a careful discussion, it was decided that the Society should support both of these important works, and the President was authorized to make necessary initiatory arrangements.

The Treasurer's Report was read, audited by Father Leopold and Dr. Brittain, and approved.

It was agreed that the next Summer Meeting be held at either Ste. Anne de La Pocatière, or at La Trappe.

It was further agreed to send a delegate to the annual meeting of the Ontario Entomological Society.

The Secretary was directed to ask for the affiliation of our Society with the Royal Society of Canada.

Professor Lochhead was appointed to represent our Society at the Canadian Royal Society meetings, if our request should be granted.

The President reported that Mr. Auguste Dupuis was unable to be present at the meetings owing to severe illness. The Secretary was directed to write to Mr.

Dupuis expressing the sympathy of the Meeting, and our hopes for his speedy recovery.

The officers elected for the ensuing year were as follows :—

President—Professor W. Lochhead, Macdonald College.
Vice-President—Auguste Dupuis, Village des Aulnaies, Que.
Secretary-Treasurer—J. M. Swaine, Central Experimental Farm, Ottawa.
Curator of Museum—J. M. Swaine, Ottawa.

Board of Directors—Rev. Father Leopold, La Trappe.
Dr. Thomas Fyles, Ottawa, Ont.
Rev. Brother Victorin, Longueuil, Que.
A. F. Winn, Montreal.
Professor L. S. Klinck, Macdonald College.

Auditors for the ensuing year—Dr. Brittain, Macdonald College.
W. P. Fraser, Macdonald College.

The Regular Meeting of the Society was opened by President Lochhead at 3 p.m., in the Lecture Room of the Biology Building.

The following papers were read and discussed, and appear in full in the body of the Report :—

THE ECONOMIC IMPORTANCE OF BIRDS: W. P. Fraser, Macdonald College.

THE CARE OF THE FARM WOOD-LOT: J. M. Swaine, Ottawa.

TWO DISEASES OF CELERY: E. M. Straight, Macdonald College.

THE PLUM LECANIUM: J. C. Chapais, St. Denis-en-bas.

REPORT ON A LIST OF THE LEPIDOPTERA OF QUEBEC: A. F. Winn, Westmount.

REFRIGERATION AND KEEPING QUALITIES OF FRUIT, AS INFLUENCED BY FUNGOUS DISEASES : P. I. Bryce, Macdonald College.

OUR INSECT AND OTHER ALLIES: Dr. Thomas Fyles, Ottawa.

The Evening Meeting was held in the same room, opening at 7.30 p.m.

The President's Address was read by Professor Lochhead, and appears in full below.

The Annual Address of the Society was then delivered by Dr. C. Gordon Hewitt, Dominion Entomologist, Ottawa.

Dr. Hewitt spoke upon " Insect Parasitism." The nature of the parasites and their method of work were very clearly discussed. The lecturer dwelt upon the agency of these friendly insects in controlling such pests as the Spruce Bud Worm, in Canada, and the Larch Saw-fly in Europe; and described the efforts being made to introduce into America European parasites of the Brown-tail Moth, the Gypsy Moth, and the Larch Saw-fly.

The lecture was fully illustrated by a series of excellent lantern slides; and was much appreciated by the large audience.

THE PRESIDENT'S ADDRESS

Gentlemen :—

This is the fourth time I have had the pleasure of welcoming you to our Annual Winter Meeting at Macdonald College. Our previous meetings have been well attended, and the papers presented have been interesting, thoughtful and instructive. Our three Annual Reports, published by the Department of Agriculture, and containing the papers presented at the meetings, have been much appreciated by those most interested in the care and preservation of cultivated plants.

SUMMER FIELD MEETINGS

According to the Constitution of our Society, a Summer Field Meeting is held every year. For the past two years this meeting has been held at La Trappe, and on both occasions it has been very successful. Those of us who were present will not soon forget the pleasant excursions about the gardens, orchards, and the fields of the lands of the Trappist Fathers; the kind hospitality of our hosts; and the enthusiasm of the students at the gatherings in the hall where the collections were discussed. Such meetings have, in my judgment, a far-reaching effect. They awaken enthusiasm in those persons already interested in the study of insects, fungous diseases, and weeds; and they often arouse an interest which had remained latent on account of the lack of a proper stimulus for development. Our Reports also have a similar stimulating effect upon young workers who found it difficult heretofore to get information helpful in their work.

Since our last meeting here two or three most useful works have appeared. The Report of the Seed Commissioner for the period from January, 1905, to March, 1911, contains a very complete illustrated description of the weeds classed as noxious under the 1911 Order in Council. The farmers are indeed fortunate in having at their disposal a number of excellent bulletins dealing with the weeds of Canada. The Seed Commissioner in particular must be congratulated on the most valuable " Farm Weeds of Canada " and the lately published Report.

THE WEED PROBLEM IN QUEBEC

The weed problem is a serious one in the Province of Quebec, and every bulletin and report that helps the farmer to deal more effectively with the weeds is heartily welcome.

It is not difficult to explain the present situation. The factors that have been operating for many years are :—

(1) The sowing year after year of grain and timothy seed that contained large numbers of noxious weed seeds ;

(2) A general lack of attention to the cutting of weeds before they seeded ;

(3) A system of farming that allowed for no periodical cleaning crop, such as corn and roots ; and that permitted meadows to lie undisturbed for many years, so that couch grass and ox-eye daisy were able to flourish without hindrance ; and

(4) The general abandonment of the sheep industry, so that weeds in pastures and waste lands were left undisturbed.

The solution of the weed problem involves, therefore, some radical changes in general farming as practised over large areas of this Province. In fact, the solution means the adoption of a more up-to-date system of rotation of crops and cultivation of the soil, for by no other means can the weeds be controlled. Many of our best farmers have already seen the remedy and are applying it, but it is a regrettable fact that a large majority of the farmers have not yet realized the seriousness of the situation, and are going along in the old rut.

During the past summer I spent three weeks in the Eastern Townships in a study of the Paint Brush or Orange Hawk-weed. I visited the counties of Richmond, Sherbrooke, Brome, Missisquoi and Huntingdon, and conferred with many farmers, good and poor alike. I found that the farmers who practised good farming had no fears of the Paint Brush in fields they could cultivate. I found also that where sheep were kept the weed was held in check in pastures and rough lands. Here then was the solution of the Paint Brush problem—good farming and the keeping of sheep.

REPUBLICATION OF PROVANCHER'S " FLORE DU CANADA "

There is another matter to which I beg to refer. Many years ago Abbé Provancher published a work entitled " Flore du Canada," in two volumes, which has been out of print for some years and is now very difficult to procure. No work on systematic botany has taken its place in Quebec, consequently this phase o study of plant life has been to a large extent neglected in the French schools of this Province. I would therefore suggest that this Society request the Government of the Province not only to reprint a revised edition of Provancher's work, but also to publish a school edition of the same. The publication of these two editions would give a stimulus to the study of plants, and indirectly would tend to a better knowledge of weeds on the part of the rising generation.

PROGRESS IN THE STUDY OF ECONOMIC ENTOMOLOGY

In my last year's Address to this Society I made a suggestion that a great impetus would be given to the study of the injurious insects of this Province if a carefully prepared set of such forms were placed in each of the normal schools. To do this, however, would require considerable labour in the matter of collection and preparation, but the Society should undertake it if the expenses of the work were borne by the Government.

I venture to make another suggestion in connection with this one, which is that a "Hand-book of Economic Entomology" should be prepared and published by the Government for the use of the schools, the farmer, the fruit grower and the vegetable grower. This book would explain the sets given to the normal schools, and at the same time would be a compendium of information in the identification and control of injurious insects.

An excellent text book on Economic Entomology has just been published by Wiley & Sons, New York. It is the work of Professor Sanderson, of West Virginia Agricultural College, late of New Hampshire, and is entitled, "Insect Pests of Farm, Garden and Orchard." It has been carefully compiled from the most recent publications, and is very fully illustrated. It will serve a useful purpose as a text book for classes in agricultural colleges, and as a ready reference work for the man who desires to inform himself regarding the insect pests of his crops.

In this connection I may also call your attention to the excellent publications of the International Institute of Agriculture, more especially to the "Bulletins of the Bureau of Agricultural Intelligence and of Plant Diseases," which summarize the most important publications of the world relating to diseases of crops induced by fungi and insects. These summaries, prepared by experts, are most valuable to the scientific worker, inasmuch as they enable him to find out readily what his co-workers in foreign countries have done.

PROGRESS IN THE STUDY OF PLANT DISEASES

Great progress has also been made during the last few years in our knowledge of plant diseases. Not only have the causal factors been ascertained for most of our more common plant diseases, but also some of the factors that predispose plants to disease. The causal factors are usually either bacterial or fungal; and their life history must be left to specialists to work out. The control of the predisposing factors is to some extent, at least, a matter of good cultivation and careful breeding. For example, it is well known that unfavorable conditions for the normal growth of a plant render it liable to attack by fungous organisms. Such unfavorable conditions are frequently too much moisture, poor drainage and aeration, etc. Growers of plants have long been aware of these facts, but a mistake was made in confusing these conditions with the real causes. The fungous organisms frequently can do nothing until the arrival of these unfavorable conditions. "If the farmer and gardener gives special attention to the fertility and drainage of his land, procures the best seed, and by proper planting and cultivation secures vigorous plants from the start, and by proper care endeavors to keep them in this condition until the product is matured, he will have accomplished more in preventing loss from fungous diseases than he would accomplish by the best remedies known applied to half-starved plants."

We know also that certain varieties of a species of plant are more resistant than other varieties of the same species under similar treatment. We are beginning to understand some of these cases through the recent studies of the laws of heredity as revealed in Mendelism. In some cases it has been shown that immunity and susceptibility are hereditary, transmissible characters. It is possible, therefore, to combine in a single plant through hybridization immunity with other good qualities.

Without discussing the great importance of this phase of plant breeding, I shall pass on to discuss another phase which has been recently studied, viz., some factors relating to the immunity of plants to disease.

IMMUNITY OF PLANTS TO DISEASE

It has long been a matter of common observation that some plants are less susceptible, or are more immune, to disease than others. It has frequently been noted, for example, that individual plants in a field, garden, or orchard escape the ravages of some disease which overtakes the others. As to the cause of this immunity, botanists are not agreed. For a long time the main factor in immunity was considered to be the structure of the external coat or epidermis. For example, it was believed that plants with a thick epidermis, or with few stomata, or with a thick coating of hairs, were more resistant to disease than plants with a thin epidermis, or with many stomata, or with few hairs. Recent researches, however, go to show that the anatomical structure has nothing to do with the question of immunity. Immunity depends upon the physiological reaction of the fungous protoplasm to the cells of the plant attacked. The cells of the susceptible host plant contain chemical substances which have the power of directing the movements of small organic cells, either positively by attacking them, or negatively by repelling them.

It has been observed that in some cases the fungous spore germinates and enters the stomata, but is unable to develop a mycelium within the tissues. This result is probably due to the formation of anti-toxins, or other substances, which destroy the enzymes or toxins of the fungus.

Infection occurs, therefore, when the anti-body in the host is unable to overcome the enzyme or toxin of the fungus, and immunity is the condition of the host when the anti-body is able to destroy the toxin or enzyme of the fungus.

The cells of each species of plant produce under normal conditions their own particular substances which prevent their infection by all fungi except those that have the power of overcoming these substances. If, however, a plant becomes affected by injury, or by unsuitable surroundings, such as heat, light, water, etc., so that its vitality is weakened, it may be unable to produce the anti-bodies necessary to resist the entrance of certain fungi, and thus becomes susceptible to disease.

Some recent studies by Dr. M. T. Cook, of Delaware Agricultural Experiment Station (Bulletin 91), go far to show the important part played by tannin in plant cells in warding off fungous attacks. This substance is a very common constituent of most plants, and was for a long time considered as a waste product. Pfeffer, the great physiologist, however, says that it is undoubtedly produced for a definite purpose, and is not a mere by-product under all circumstances. Tannin is abundant in the bark, and in the coats of the fruit and seed, and quite conspicuous in injured parts of plants, especially in galls produced by insects and fungi.

The presence of tannin in plant tissues may have some bearing on immunity. Von Schrenk (Bulletin 14, Bureau of Plant Industry, U. S.) says : "Wherever organic food is stored bacteria and fungi are sure to grow with great rapidity if moisture is present. This is one of the reasons why sapwood rots so much faster than heartwood. It (heartwood) is further protected by antiseptic bodies, such as various resins, the tannins, etc."

Dr. Cook in his recent Bulletin (Delaware, No. 91) shows that "tannin has a tendency to retard or inhibit the growth of fungi," that "it is the tannin and not the cell wall that is most important in checking the growth of mycelium," that "some spores are more resistant than others of the same species," and that "parasitic forms are more sensitive to the action of tannin than the saprophytic forms." Dr. Cook concludes : "It appears that tannin is an important factor (in chemotactic action) and that its importance varies in accordance with the other substances with which it is associated in the cells of the host plant. While tannin no doubt serves as a protective agent, its efficiency in this direction will vary somewhat with the character of the other substances within the cell. This may account for the variation in power of resistance between species, varieties, and individual plants."

There is, however, no reason to believe that tannin is the only chemotactic substance in the cells of the plants. Both organic and inorganic acids act repulsively towards fungi. Generally speaking, ammonium compounds, phosphates, peptone, asparagin and sugar are good attractive agents.

The degree of concentration of the solution is also an important factor in chemotaxis.

SOME PROBLEMS REQUIRING SOLUTION

Notwithstanding the progress that has been made in the study of economic insects and fungi, it is very evident that more investigation must be done before our Quebec fruit growers, vegetable growers and farmers will be in a position to control the ravages of certain pests. I shall briefly call your attention to a few of these insects and fungous diseases that require further investigation.

The Plum Curculio is a serious pest in some of our best apple districts, such as Abbottsford and Covey Hill. While the life history of this insect is fairly well known, the present methods of control are far from effective. It is probable that a careful field study carried on throughout one or two seasons in the infested districts would reveal better methods of control.

Similarly, the Apple Maggot or Railroad Worm requires additional study, not in the laboratory but in the orchard.

Again, the Black Rot Canker is prevalent in many apple orchards and requires attention. The death of many twigs and branches is not due entirely to sun-scald, as many orchardists are inclined to believe; but in many cases to the attacks of the Black Rot Fungus. This disease can also be best dealt with in the orchards.

Further, the Potato Scab problem is one which requires more study than has been given to it. In some districts this fungus causes great losses and is difficult to control.

I have mentioned these four pests, for I believe they require first, and, I may say, immediate attention. Money could be spent to great advantage if two or three young men with a fair knowledge of insect and fungous pests were enabled to devote one or two seasons to the study of these pests in the field. We regret that the appropriation to our Society is too inadequate to permit it to take up the matter. We are willing, however, to do everything in our power to assist in the solution of the problems concerned.

In conclusion, let me remind our members that our Society is doing a most valuable work in disseminating useful information among the plant growers of Quebec. Although we get no financial return for our labors, yet we have the proud satisfaction of knowing that we are helping a large number of persons who need help. We thank the Department of Agriculture of Quebec for their continued assistance in this good work.

THE CARE OF THE FARM WOOD-LOT

J. M. Swaine, Assistant Entomologist for Forest Insects, C. E. F., Ottawa

Throughout the greater part of Eastern Canada there is a wood-lot of more or less value attached to nearly every farm. It seems that the wood-lot is commonly looked upon as a sort of wood mine. The attitude of the farmer too often is to obtain from it his supply of fuel, the poles and posts that he requires, and such dimension timber as it may afford; but to give no thought whatever to the conservation of the supply. As the capital is constantly decreased, with little reseeding, and no attempt at planting, the wood-lots are nearing the vanishing point in many districts. This is unfortunate. If the wood is of fair size, if one-fortieth of its wood content will meet the season's requirements, it may be kept in good condition indefinitely, yielding a constant supply of fire-wood, poles and posts for generations.

Aside from the direct revenue which it may yield, a wood-lot has certain indirect, but not inconsiderable, values. It covers, or should cover, the poorest uplands. If it is happily located in relation to the rest of the farm it may, if properly cared for, act to some extent as a reservoir, holding the soil water to be gradually distributed to the lower levels. This is particularly true if streams flow through the woods towards the rest of the farm. It serves as a home for the birds, or with some attention may do so. The wild birds are remarkably effective in destroying insects and weed-seeds. The wood-lot may be of much value as a beautiful strip of forest, as a private park.

In order to obtain the best return from forest land, one must give to it some considerable thought, some little time. In particular, it is necessary to attend to two matters : the conservation of the soil moisture and the proper reproduction by seeds or seedlings.

The Conservation of Soil Moisture.—Under good forest conditions, the moisture is held in the woods by the dense " crown cover " of boughs overhead, which shuts out the direct rays of the sun, and by a " soil cover " of shrubbery and humus. In dense woods the circulation is slow, and winds are unable to penetrate to exert their drying effect. Wood growth requires an immense amount of moisture, and when the supply is deficient, the less vigorous parts dry up or are killed by insects and fungi. It is of much importance, therefore, to preserve the " crown cover," for upon it will depend the nature of the " soil cover," and in improvement-cuttings and crop cutting by the selection method, care should be taken not to remove sufficient wood to allow free entrance of light from above. When a sod of grass and weeds begins to form beneath and between the trees one can be sure that the crown cover has been too much broken ; too much light is entering from above.

A belt of dense woods should be left or provided about the edges of the lot to act as a " wind-belt." This by hindering the free entrance of air is extremely effective in retaining soil moisture. Norway spruce makes an excellent belt for this purpose.

The forester speaks of " improvement cuttings." These are made for the purpose of putting the woods in better shape for future development. By these cuttings it is intended to remove dying, dead and useless wood, species of little value, iron-wood, blue-beech, balsam-fir, etc.; trees which are being crowded out, and are using space and moisture that their neighbors can better utilize. From a large wood-lot, fire-wood may be obtained from these cuttings, saving the main body of the lot for development into more valuable material.

Reproduction may be by artificial planting, but usually by so arranging the cuttings that a natural reseeding results. Much of our woods consist of conifers, which, excepting the arbor-vitae, reproduce by seeds alone. Many deciduous trees sprout readily and produce a dense growth of shoots from cut stumps and roots. Wood so reproduced is known as " coppice." It makes satisfactory fire-wood, poles and posts, and small timber ; the best dimension timber is produced by seedlings.

The regular crop cuttings may be conducted under various methods, but some definite plan should always be prepared, with special regard to the particular conditions of the lot in question. Cutting in Sections, whereby one section of the lot is entirely removed and replanted each year, is a simple and perfect method, but not likely to commend itself to the busy farmer.

The Selection Method culls the individual trees desired. It is the only method for securing dimension timber from a mixed woods.

The Strip Method cuts narrow strips through the woods, removing all trees and shrubs and leaving reseeding to the seed-trees along the sides of the strips. It is not the best method for administering a wood-lot.

The Group Method, which is the one best adapted for our purposes, makes small clearings at selected places, and, from year to year, enlarges the clearings by narrow belts. Reseeding takes place from seed-trees about the edges of the clearing. The reseeding process is supplemented by direct planting of seedlings when required, or when special kinds of valuable trees are desired.

The locations of the clearings—one or two or more—are selected so that mature clumps will be used, sections too open cleaned and reforested, clumps of poor quality replaced by a more desirable growth, and like desirable results obtained.

The size of the first clearing should be from one-quarter to one-half an acre. The width of the concentric belts—cut year by year—should not be greater than the height of the surrounding seed trees. The clearings should be complete and, if the ground is sodded, a plow should be used. If there are not sufficient seed-trees in close proximity, replanting with seedlings becomes necessary.

The Group Method, the Selection Method and Improvement Cuttings may proceed together. If the lot is a large one, the improvement cuttings will furnish most or all the fire-wood needed, together with culls and " slash " from the clearings.

A proper forestry system pays especial regard to the crown cover, so that the soil cover will remain in condition and protect the soil moisture. It makes thoughtful provision for reforesting and introduction of valuable trees. It removes all worthless and dangerous dying wood and surplus trees, which hinder the growth of those of more value. It removes each season the greatest amount of valuable product consistent with the preservation and proper development of the forest area.

This subject is without question of much importance, as the diminishing and neglected wood-lots everywhere testify. A strip of woods is like any other crop, in that it may be neglected, wasted, and ultimately destroyed ; or conserved so as to give a reasonable return for the acreage covered and the attention given it. Furthermore, a wood-lot, properly administered, has peculiar values which attach to no other crop, and which add appreciably to the commercial and living values of any farm.

The forest insects injurious to wood-lots may be grouped as: leaf-feeding caterpillars and saw-fly larvae, bark and wood-boring beetles and their larvae, wood-boring caterpillars, and aphids and scale insects.

The leaf-eating caterpillars and all other insects feeding on the leaves of trees may, of course, be killed by poison-sprays. Spraying can be successfully employed to protect shade trees, but is usually quite out of the question on even a small wood-lot. For the control of such insects we must depend largely upon Nature's methods of control, assisting wherever possible. Nature regulates the numbers of the destructive insects by: adverse weather conditions, upon which we can exert no control; insect parasites, whose friendly activities man is just now beginning to appreciate and to assist, and insect-eating birds, which we have been industriously and very successfully attempting to exterminate for several generations.

By protecting the birds, and encouraging them to remain about the wood-lot and farm and rear their young there, one can do much towards controlling the leaf- and bark-feeding insects.

It is always advisable to destroy, while they are small, the tents of the tent-caterpillars, and the fall web-worms found on shade trees, but little direct work of this kind will be feasible over any considerable area. If we ever have to control the Brown-toil Moth and the Gipsy Moth in this Province such work will, however, be necessary no matter what the cost.

The Aphides or Plant-lice have been injurious in this Province for some years, particularly to pines. They do not, fortunately, kill the trees. Certain gall-producing aphids of the genus Chermes, **abietis, similis** and **floccus,** are seriously injuring the spruce in various localities. They can be controlled on shade and ornamental trees by spraying with whale-oil soap, or kerosene emulsion; under forest conditions they are quite beyond our control.

Certain scale-insects allied to the genera Lecanium and Kermes have recently been injurious to broad-leaved trees of several species, and to spruce. These again can be controlled on a limited number of valuable trees, but not in the forest.

The destructive bark-boring insects belong chiefly to several Coleopterous families of which the Ipidae is the most important. Certain of the bark-boring species of this family are extremely destructive, perhaps the most injurious of all our forest insects, and, fortunately, they are not too difficult of control, even under forest conditions, when dealt with promptly and intelligently.

Our wood-boring species belong to the Coleopterous families Ipidae, Cerambycidae, Buprestidae, Ptinidae, and others, and the Lepidopterous families Sesiidae and Cossidae. These drive their tunnels more or less deeply into the wood, which is thereby injured for all valuable purposes.

The control of such bark and wood-boring insects in wood-lots consists in removing all injured, dying and dead wood during winter and using it for firewood, or otherwise burning it, before spring. All useless slash, shelf-fungi, and other useless but dangerous parts should be burned before spring. All injured or dying trees with the under-bark filled with bark-beetles should be used for firewood during winter, or felled and barked before spring. The bark should be burned. Stumps should be cut as low as possible, and at least partially barked. Logs which must be left in the woods during the months of June and July should be barked before the last of May. Care should be taken to injure the standing trees as little as possible during cutting operations. Torn bark and broken limbs are certain to be entered by insects and fungi.

SOIL TREATMENT WITH CHLORIDE OF LIME FOR FUNGOUS DISEASES

J. W. Eastham, Assistant Botanist, Central Experimental Farm, Ottawa.

In the case of many of the diseases of plants due to parasitic fungi it is known that the parasite has the power of existing in the soil for a considerable period, often extending over several years, and during this time any susceptible crop planted in the soil is likely to succumb to disease. In what condition the organism exists during this time is in many cases not known, but it is probable that many fungi which are capable of causing serious diseases in certain plants are also able, in the absence of suitable hosts, to exist on the dead organic matter in the soil. In other cases it is possible that the resting spores of the fungus remain dormant for varying periods of time so that successive germinations occur in successive years, while in yet other instances the disease-producing organism is kept alive in the land through the agency of weeds allied to the crop host-plant. Examples of plant diseases which after once getting established in the soil are capable of attacking crops planted therein for several years are potato scab, potato canker, club-root (or finger-and-toe), of crucifers and the root-rots due to species of Rhizoctonia.

In such cases, it is, of course, highly important to avoid the infection of land at present free from such diseases. To this end only seed or tubers apparently quite sound should be used, and if possible selected from healthy stock. Even then, treatment of seed or tubers with such substances as formalin or corrosive sublimate to destroy any adherent disease germs is often a wise precaution. Care should also be taken that refuse from a diseased crop does not find its way to the manure-heap and thus demonstrate one of the most potent means of disseminating disease. Where, however, the soil is already infected it becomes necessary either to " starve out " the parasite by growing, for a series of years, only those crops which are not attacked by the particular parasite in question, or to adopt some method of treating the soil whereby the parasitic organism is killed. To obtain such a complete or partial sterilization of the soil several means have been employed, as for example, the " firing " or dry heating of the surface soil, the injection into the soil of steam at high pressure, and the application of certain chemicals. These methods, however, are on the whole too costly to find employment for any but very special field crops, though it is often worth while to make use of one of them for greenhouse or seed beds, or where very intensive cultivation is practised. Sterilization by suitable chemicals has the advantage of not requiring the fitting up of special apparatus, and the application of a solution of formalin is perhaps the commonest method in use. It is, however, rather expensive and it is often a considerable time before the formalin has evaporated sufficiently to make sowing or planting safe.

Another chemical that seems to promise good results in many cases is chloride of lime, or bleaching powder. It has long been known that this substance possesses powerful germicidal properties. It is largely used as a disinfectant, and even very small quantities are found effective in improving the quality of contaminated water which has to be used for drinking purposes. The results of some careful experiments conducted in Germany to test its value as a remedy for certain soil diseases have recently been published* and a summary of them may be of interest. In several florists' gardens beds which had grown unproductive when devoted to such plants as lilies, violets, pinks, etc., were used. In other cases, soil so badly infected with the club-root organism that cruciferous plants could hardly be grown was selected. Two methods of applying the substance were followed. In one case it was mixed with water and applied partly over the surface and partly in hollows made in the ground. In the other case, the dry powder was scattered over the surface of the soil, hoed or otherwise worked in to a depth of several inches, and the soil well watered immediately. Apparently, however, one method was about as efficacious as the other. It was found that in the soil the chemical underwent a rapid alteration into harmless substances, so that the planting of the crop could be safely undertaken in some cases as early as ten to twelve days after the application. When the bleaching powder was applied at the rate of half a pound or more per square yard the results were in most instances very favorable, disease being prevented or much reduced, many injurious insects and nematodes killed, and the vigour of the plants much increased. Since bleaching powder can be purchased in 300 lb. barrels at less than two cents per pound it would certainly seem worth while to give this method of soil treatment a trial in many cases where intensive cultivation is practised, and the soil has become much reduced in productivity owing to the accumulation in it of injurious organisms.

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*Über Bodensäuberung *v.* R. Emmerich, W. Graf zu Leivingen, *u.* O. Loew, Centbt. *f.* Bact. 31; 466-477.

THE LEPIDOPTERA OF THE PROVINCE OF QUEBEC.

A. F. Winn, Westmount, P.Q.

At our last annual meeting I read, on behalf of the Committee, a report on the progress made on the proposed list of Insects of the Province of Quebec. Since then, however, conditions have changed, particularly as our convener, Mr. Swaine, has taken himself off to Ottawa and has not brought us together, and to put the matter briefly the complete list has not been completed.

What attitude the society will now take remains with yourselves. Personally, I am still of the same opinion that the existing records of insects of all orders should be gathered together and published, incomplete though they may be, as a basis for a more perfect list, or lists, to follow, perhaps ten years hence.

It was, I think, our President's original suggestion that this society should prepare the list in parts, and perhaps that plan will now meet with your approval.

The amount of time required for preparation of a first faunal list is surprisingly great. I had no idea of it, I confess, and am very glad I kept no record of the time expended on it, but the list of Lepidoptera, or butterflies and moths, is now written up in book form and is available for the printer at any time, if deemed worthy of publication, and funds are available. Nearly 1,300 species are listed with a considerable amount of information regarding localities, dates of appearance and the larval food plants, following closely the lines of the late Prof. Smith's "New Jersey List," which has become such a useful book that three editions have now appeared.

So far as I can see the publication of lists from this and other provinces should in no way clash with the plans for a more comprehensive list covering the insect fauna of the entire Dominion, but, on the contrary, should be of the greatest assistance in its preparation. Mr. Chagnon is still willing to put in list form the Coleoptera of the Province from the information and notes that he has, and Mr. Moore will do the same with the Hemiptera. Of the other orders a considerable number of species are card-indexed, and so far as they go, they could be published, leaving to future students the pleasure of listing from two to ten times the number originally on record.

CUTWORMS, AND HOW TO CONTROL THEM

Arthur Gibson, Chief Assistant Entomologist, C.E.F., Ottawa.

No insects do as much general damage in vegetable gardens as the caterpillars commonly known as cutworms. They are present every season in more or less numbers in almost every district in Canada. Although their destructive habits are fairly well known, it is, however, remarkable how few growers take the necessary precautions to protect their crops from their ravages, or to destroy the insects when their work is seen. Cutworms do not, in fact could not, work in such a manner as to render it difficult to detect their presence. When they are abundant, the evidence is only too apparent, and all who have a garden, whether this is small or large, know what the results will be, if these caterpillars are allowed to continue unchecked their work of destruction. The damage done by our common cutworms amounts to an enormous sum of money every year, and this loss could be largely prevented if growers would adopt the proper measures.

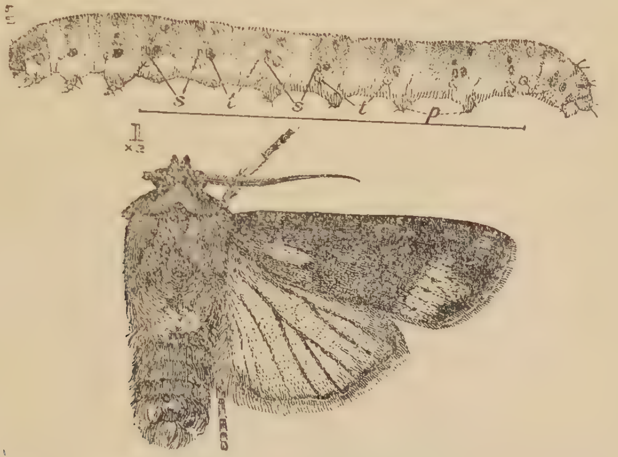


Fig. 2—Cutworm and moth, *Agrotis ypsilon* Rott. Both twice nat. size. (Copied from Swezey.)

In Eastern Canada there are about a dozen different kinds of cutworms which any season are liable to do much damage. The most regularly occurring species is the Red-backed cutworm. This one never, it would seem, fails to appear in destructive numbers.

The habits of cutworms in general are similar. They all have the cutting habit developed to a high degree, and when not feeding at night they hide beneath the soil within a short distance (an inch or so) of the plants upon which they have been feeding. When a plant is seen to have been cut off, the cutworm will most likely be found coiled up beneath the surface, close to the injury. Under normal conditions they feed only during the night and rest during the day, but when food becomes scarce owing to their occurrence in large numbers, they migrate during the day and if in extraordinary abundance, oftentimes assume the marching habit so characteristic of the army-worm. In general, cutworms are similar in color to the ground in which they hide. They are cylindrical in shape and when full grown are about an inch and a half, or more, in length.

The Red-backed cutworm is so named owing to the reddish colour of the upper portion of the body. The Greasy or Black cutworm is of a uniform dark greasy-gray or blackish colour. The Variegated cutworm ranges from pale gray to almost a dull brown and is marked on the back with several conspicuous yellow spots. The Dark-sided cutworm is dull grayish, some having a pale greenish or other light coloured tinge. The sides are noticeably darker than the rest of the body. The White cutworm, which often does serious injury by climbing fruit trees and destroying the buds, etc., but which also works in vegetable gardens, is of a general whitish colour, without any distinctive markings. The W-marked cutworm is easily recognized by the series of conspicuous W-marks on the back. The sides of these marks are bordered with bright pale yellow. The Spotted cutworm has a row of triangular shaped blackish marks on either side of the back, those on the rear segments being the most conspicuous. All of the above are very common species and are the most destructive kinds which occur in Canada.

Preventive measures for the control of cutworms consist of ploughing deeply, in fall, all land where the caterpillars have been present. Many eggs are deposited by adult moths after midsummer on weeds, remnants of crops, etc. If such are gathered up and burned, all useless plants which would attract the moths for the purpose of egg-laying will be removed. If not gathered up, the land should be ploughed deeply. Such a practice will destroy the eggs and young cutworms as well as many other kinds of hibernating insects. Cabbages, cauliflowers, etc., when set out can be protected from cutworms if a band of tin or paper is placed around the stem. Old tomato or other tins in which vegetables have been canned are very useful for this purpose, and if thrown into a bon-fire the tops and bottoms will fall off, leaving the central piece of tin, which, if cut down the middle, will be sufficient for protecting two plants.

The most important remedial measure is the prompt application of the poisoned bran remedy as soon as the presence of cutworms is detected. This is made by moistening the bran with sweetened water and then dusting in Paris green in the proportions of half a pound of Paris green to fifty pounds of bran. The bran should be noticeably moistened (but not too much so to prevent its being crumbled through the fingers) so that when the poison is added it will adhere to practically every particle. One half a gallon of water in which half a pound of sugar has been dissolved is about sufficient to moisten fifty pounds of bran. If more convenient, molasses may be used, or about the same quantity of salt. As soon as cutworm attack is noticed the mixture should be applied, preferably after sundown. When the cutworms come out to feed at night they readily find the bran which they are very fond of, and will be killed in large numbers, the attack stopping almost immediately. If the mixture is put out during a warm day it soon becomes dry and is not so attractive. From fifty to one hundred pounds of poisoned bran is sufficient to treat an acre, the actual amount depending on the closeness of the plants. For such crops as cabbages, cauliflowers, onions, etc., the method of spreading the mixture is to have a sack hung about the neck, and by walking between two rows and using both hands it may be scattered along the rows on either side.

Fresh bunches of any succulent vegetation, clover, grass, etc., which have been dipped into a strong Paris green mixture (one ounce of Paris green to a pail of water) may be placed at short distances apart between rows of vegetables or roots, and will attract many cutworms and protect the crops from further injury.

For cutworms which feed almost entirely underground the above baits are not of much value. When such cutworms are troublesome, the land should be kept as free as possible from long grass and weeds so that the female moths will not be attracted to such vegetation for the purpose of egg laying.

When cutworms assume the marching habit it becomes necessary to plough deep furrows in advance of their line of march. The progress of the caterpillars is thus stopped, and when a furrow is entered by them a log drawn by a horse may be dragged through it and the cutworms will in this way be crushed. If post holes are dug in the furrows at an interval of about ten or fifteen feet apart a large number of the cutworms will fall into them, and they can then be killed easily by means of the blunt end of a post, or such object, or by pouring a little coal oil over them.

OUR INSECT AND OTHER ALLIES

Rev. T. W. Fyles, D.C.L., Ottawa.

One purpose our Association has in view is the preservation of plants from injurious insects.

In the pursuit of this, it is, in the words that an old Divine made use of with reference to the cultivator of the soil, " a co-worker with God," for the Almighty has formed and commissioned a vast army to keep down the numbers of the devastators of our fields and vineyards, our orchards and gardens.

Among the most efficient battalions in this vast army are the numerous predaceous and parasitic **insect** tribes; and so admirably do these defenders of vegetation carry on their operations, that it is only under peculiar circumstances that the spoilers seem, for a time, to gain the ascendency. When they do so they are justly regarded as **plagues**—occasioning alarm, annoyance, and loss to mankind. What serious pests the Hessian Fly, the Midge, the Locust, the Canker-worm, the Phylloxera and the Scale have shown themselves!

Of insects arrayed against the hurtful kinds there are, in common parlance, many sorts of wasps, bugs, beetles and flies—in scientific terms, many species of Hymenoptera, Hemiptera, Coleoptera and Diptera—with a few of other orders.

I do not intend to inflict upon you long lists and descriptions of our insect friends. I wish rather, by advancing a few remarkable instances, to draw your attention to the various **modes of operation** pursued by the creatures that, from our standpoint, we regard as friends.

I would remind you that insects pass through four stages of existence:—(a) the Egg, (b) the Larvae, (c) the Pupal, (d) the Imago stage. In every one of these the insects injurious to vegetation are liable to destruction by their foes.

(a) Much has been written of late years on injuries wrought by the Tussock Moths. Mr. W. Hague Harrington of Ottawa once raised from the eggs of these mischievous moths a number of minute Proctotrypids of the species named by Fitch **Telenomus orgyiae.** This wonderful little insect is black and highly polished, with yellow markings on the limbs, and with beautifully fringed and hyaline wings—it is an insect gem!

Fancy the egg of this minute creature deposited in the egg of the moth. It hatches, and the tiny grub from it luxuriates on the store of food contained in its little cell. It finds this sufficient for its growth; and, attaining this, it goes into the pupal stage of restful development. At length it breaks forth into the outer world, a creature full of lusty life and activity—**and yet it is a creature only eight-tenths of a millimetre in length.** We are lost in admiration of Him who formed this insect, so minute, so brilliant, so perfect in every part.

God's majesty is seen in little things! His Almighty Power appears, both in the animalcule whose ocean is a drop of water, and in the huge Baloena that tempests the mighty deep.

In America, Telemoni have been reared from the eggs of 14 species of Lepidoptera; and it cannot be doubted that many other kinds of egg-feeders will yet be discovered.

(b) In forming the collection of Lepidoptera that is now in the Provincial Museum at Quebec, I endeavoured to raise from the larvae as many kinds as possible, that the specimens might be perfect. I often failed—the larvae proving to be ichneumonid. I had much trouble in raising **Apatela hastulifera** S. & A. I only succeeded when I found the larvae in a very early stage of their existence, before the ichneumon (**Rhogus intermedius** Cresson), had found them. The parasitized larvae were constantly met with. They seemed to become reckless, and to make no effort at concealment; and later their empty skins were to be seen affixed to the twigs of their food-plant, and pierced with numerous holes through which their mortal foes had made their exit. It is well that the gardener should study the Ichneumonidae, Braconidae, etc., and their habits.

I have, if I remember rightly, told elsewhere of a visit I paid long ago, to a clergyman in the Eastern Townships who had a very fine garden, and was proud of it. He took me round its well ordered beds, and along its borders, expatiating upon their perfections. While we were passing a fine carrot-patch, I noticed a skin of **Papilio polyxenes Fab.** thickly studded with cocoons of a microgaster. Unlike the Rhogus I have spoken of, which attains perfection within the body of its victim, the microgaster, when full-fed, pierces the skin of its host, and spins its cocoons around it.

I drew the attention of my friend to the object before me, intending to give him a short lesson on Insect Parasites; but, in a moment, to parody a passage in "The Hermit of Warkworth,"

> The Parson turned in sudden rage,
> And at the insects flew.

Before I could hinder him, he had crushed under foot, and trampled out of existence, some scores of his best insect friends.

(c) By those who seek for them there may often be found, in the proper season, large batches of the handsome larvae of **Harpiphorus tarsatus** Say, feeding upon the Dogwood, **Cornus stolonifera** Michx. Each of these larvae when full fed goes in search of a decaying tree, stump or log, and into it tunnels its way,ejecting the **frass** and making a clean chamber for itself in which to undergo the pupal change. One fall I secured a number of such chambers with their occupants; and in the spring, when the Harpiphorus flies began to come forth, I was examining a pupa which I had drawn from its cell, when suddenly there broke from it, full of life and fire, with antennae waving, and wings quivering, a specimen of **Hemiteles mucronatus** Prov.

I have among other instances witnessed the exit of:
Ichneumon laetus Brulle from a Noctuid pupa.
Trogus fulvipes Cresson from a pupa of **Papilio turnus** L.
Exochilum mundam Say from a pupa of **Datana angusii** G. & R.

(d) Of predaceous insects that seize their victims when in the imago stage, the " Praying Mantis," **Mantis carolina** Packard, belonging to the Orthoptera, is a notable example. We were led in our childhood to regard the **Mantis religiosa** of Europe as a hypocrite seeking to devour the innocent. Must we still look upon it as such?

The Praying Mantis is not found in Canada; but we have a smaller insect, **Mantispa brunnea** Say, belonging to another order—the Neuroptera, that is strangely like it in form and is of similar habits. The Mantispa may be found in the flower heads of Solidago, waiting with arms extended to clutch its prey in its deadly embrace.

I will now, with your permission, give a few examples of agencies affecting destructive insects that feed—(a) at the roots, (b) in the stem, (c) on the foliage—of the green things upon the earth.

(a) The admirable drawings of the late Charles V. Riley have made the appearance and habits of the beetle **Lachnosterna fusca** Frőhling widely known. In figure 2 of his illustration the larva, or White Grub, as it is called, is seen feeding at the roots of a plant. But, though the creature itself lies hidden in the earth, it does not always escape destructive agencies. A hymenopteron, **Tiphia inornata** Say, finds it out, and the grub of this insect devours it.

A more remarkable agent for the destruction of the White Grub is **Cordiceps melalonthae**. This is a parasitical fungus, much like that which affects the larva of the New Zealand Ghost Moth, **Hepialus virescens,** and which has obtained for its host the name of Vegetable Caterpillar.

Some years ago, Mr. C. W. Nash, one of the directors of the Entomological Society of Ontario, exhibited, at a meeting of that society, a like fungus, growing from another root-feeder, the Wire-worm.

(b) Of insects working in the stems of plants we have a remarkable instance in the larva of that fine moth **Sphida obliqua** Walker. It affects the Cat-tail Flag (**Typha latifolia** L.) and causes its decay. It forms a cell in the thickened base of the plant, and feeds on the pithy portions of the stem. The Cat-tail Flag grows in marshy ground which is liable to be flooded, and the larva resorts to dry ground to undergo the pupal change. It is formed for swimming, and moves easily through the water, with undulations like those of an eel or water-snake. At such times its spiracular line is below the surface and the creature would drown but for a strange provision : the last pair of its spiracles are placed higher than the rest, and through these the larva breaths while on its watery way.

Can any foe reach this larva when working in the heart of the flag? Yes—I have raised, again and again, from maggots that I found preying upon it there, the beautiful little two-winged fly **Chetopsis oenea** Wied.

In September, thirty-one years ago, I was driving from Stanbridge East to Cowansville. In one part, my road led through a dense alder-swamp of considerable extent. I was driving slowly, and I noticed a small butterfly fluttering from bush to bush. I stopped my horse and left my vehicle to examine the insect. It was of the kind that was then known as **Polyommatus crataegi**—Boisduval & Le Conte—someone having found the insect on a thorn-bush. A few days afterwards, I drove back to the spot, equipped with net and pill boxes, and captured a number of the butterflies.

I was at that time in correspondence with that grand old entomologist, the late W. H. Edwards. I mentioned my captures to him, and he asked me to try to obtain particulars as to the food-plant and larva of the insect. I did try, both that season and the next, and all that I could write to him concerning the species was that I thought the name **crataegi** a misnomer, for there was not a thorn-bush in all the district in which I had taken the butterflies.

It remained for a lady to trace the life-history of the species.

Feniseca tanquinius Fab., as the insect is now called, is predaceous. Its larvae lie hidden in the white patches of the Woolly Aphis, which are so often seen on the stems of Alder, draining the sap of the plant. The larvae feed upon the aphides. I have raised the perfect insects from them many times since the days I have spoken of. Their pupae closely resemble diminutive monkeys' heads.

(c) A strange foe of leaf-eating caterpillars, and also of locusts and crickets—which are also herbivorous, is the Hair-snake, **Gordius varius** Leidy.

I have, preserved in spirits, two specimens of the same kind of leaf-eating Lepidopterous larvae. One of them is plump and fresh coloured; the other, shrivelled and brown. From the latter, the long hair-snake that is with them extruded itself. In life, the snake had been coiled, round and round, under the skin of its host—**and very close quarters it must have had there!** It is a female of its kind. In another vial I have specimens of the larvae of one of the Tenthredinidae, a **Zaraea** which feeds on the Buckbean, **Menyanthes trifoliata** L.—a swamp plant. From one of the larvae, the male Gordius that is with them made its exit.

The life history of the hair-snake is as yet incomplete. This much of it is known :—

The female lays its eggs in a long chain which resembles a length of white thread. She twists herself about this and holds it in place. In due time the eggs hatch, and strange little creatures come from them. They are only 1-450th part of an inch long. At the head they have two circles of hooks, and with these they work their way into the larvae of May-flies and Caddis-flies. In these they become encisted.

So much has been told us by Drs. Leidy and Meissner (Am. Ent. & Bot., Vol. II., pp. 193-7).

As in the case of the Trichinae, it is necessary for the young Gordii to pass into a second host, that they may reach perfection. How they do so is a mystery. It may be that when the Ephemera casts off its pseudimago dress it disburdens itself of the encisted Gordii; and that these, falling upon the herbage, are swallowed by herbivorous insects. It is certain that myriads of destructive insects become the prey of the Gordii.

Professor Leidy made a careful examination of the egg-cord of one female hair-snake, and found it to contain 6,624,800 eggs.

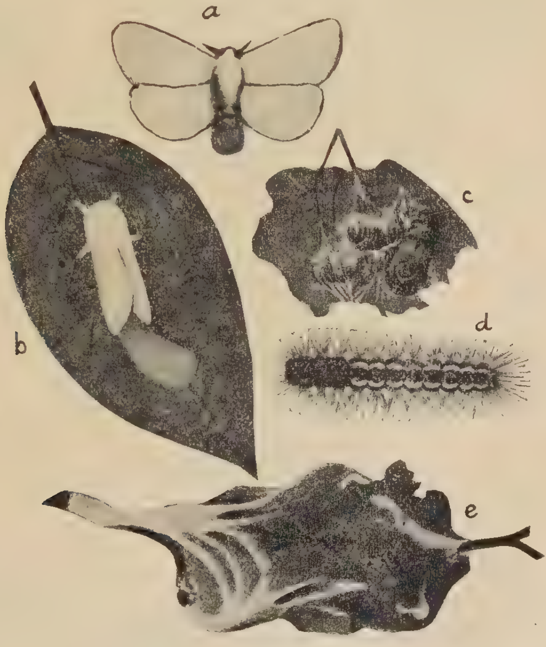
But I must not take up more of your time. The instances I have given will have afforded glimpses of the " wheels within wheels " in the grand machinery of Nature—will have afforded us an insight to the wise orderings of Providence, under which all things continue as at this day. As we muse upon them, we are ready to exclaim in the words of the **Benedicite, omnia opera,** " O all ye works of the Lord, bless ye the Lord: praise Him, and magnify Him forever."

THREE PESTS THREATENING QUEBEC.

THE BROWN-TAIL MOTH, THE WART DISEASE OF POTATO, AND THE WHITE-PINE BLISTER-RUST.

W. Lochhead, Macdonald College.

One insect and two fungous pests of great importance threaten Quebec. The **Brown Tail Moth** has not yet been reported from this Province, but it is steadily making its way north from New England. **The Wart Disease of the Potato** has been seen in Newfoundland by Mr. Güssow, Dominion Botanist, and the **White-Pine Blister-Rust** of Europe, already introduced into the United States, threatens the existence of the White-Pine plantations of this country.

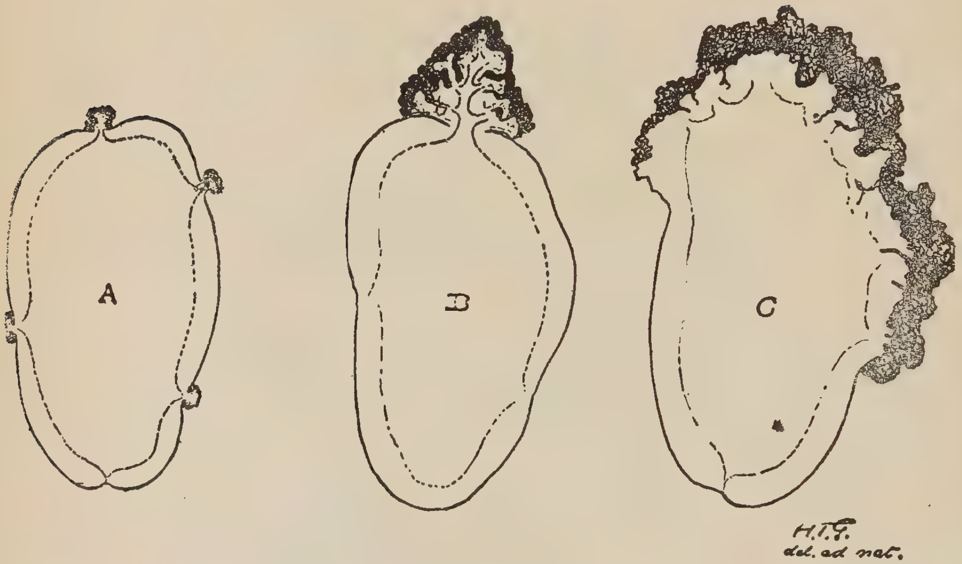


The stages of the Brown Tail Moth. *a.* moth; *b.* female depositing egg mass; *c.* cocoon; *d.* caterpillar; *c.* winter nest. (After Britton).

BROWN-TAIL MOTH, Euproctis chrysorrhoea.—In the Society's First Annual Report (1908–1909) the writer called attention to this insect as threatening Ontario and Quebec, and emphasized the need for careful watch of the over-wintering caterpillar nests on the tips of twigs of forest, shade and orchard trees. Since the publication of the above Report the Brown-tail Moth has continued to spread not only in New Hampshire and Maine, but also in Nova Scotia and New Brunswick. It appears, therefore, that its invasion of Quebec is near at hand, and it is the duty of every citizen of the Province to report the first appearance of the insect so that prompt measures may be taken by the authorities for its suppression. The following is a concise summary of the various stages of the insect:

Adult.—A white moth with the tip of the abdomen tinged with brown, and with a tuft of brown hairs, most conspicuous in the female. It expands 1½ inches. Both sexes are strong fliers, active at night, and attracted to lights. They make their appearance in July.

Eggs—Laid in brownish clusters of 150 to 300 on the leaves at the tips of the branches in July and August. Usually brown hairs are mixed with the egg-mass. The eggs are hatched by August 15th.



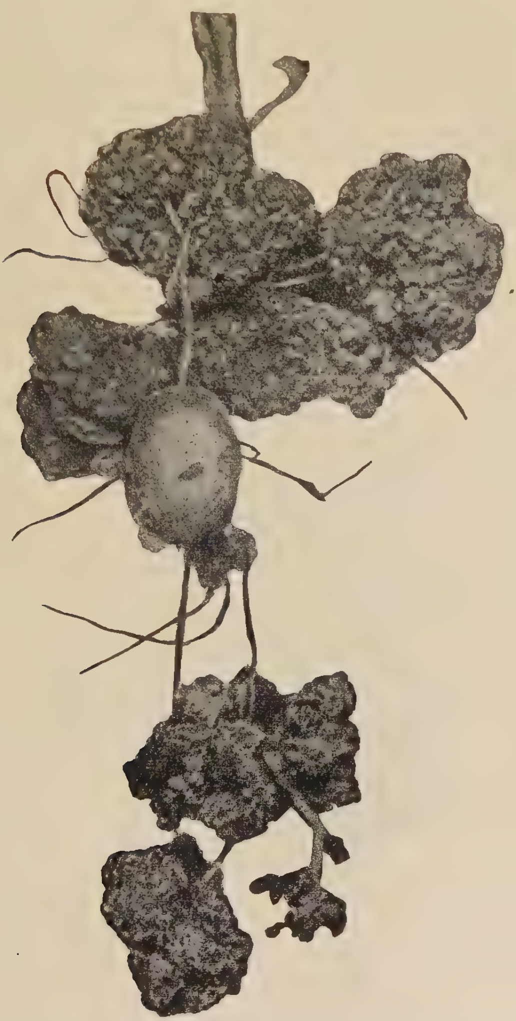
Potatoes Showing Disease of Potato Canker. Cut in Halves.

A.—A tuber showing four eyes attacked by the fungus *Chrysophlyctis endobiotica*, Schilb.
B.—A tuber showing upper eye only attacked.
C.—A tuber half covered by the excrescences caused by the fungus. (after Güssow).

Caterpillars.—When young the caterpillars are blackish, with reddish-brown hairs, and there is a row of conspicuous white spots on each side of the back.

WART DISEASE OF POTATO (Chrysophlyctis endobiotica).–Since 1896 the Wart Disease of Potato or Potato Canker has been doing much damage in Europe where it is now considered one of the worst enemies of the potato. In 1909 Mr.

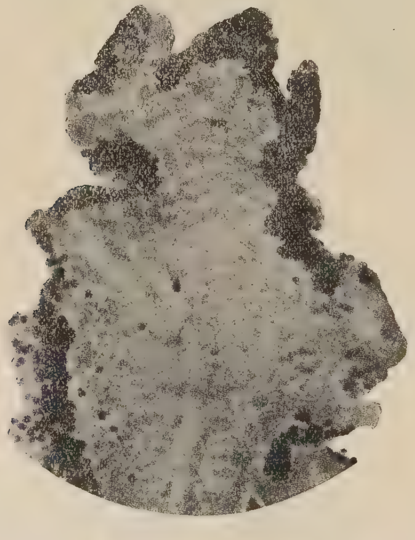
H. T. Güssow, Botanist of the Dominion Experimental Farms, who had studied the disease in England, proved that it existed in Newfoundland. Soon afterwards he published a Bulletin (A Serious Potato Disease in Newfoundland, Bul. 63 C.E.F. Ottawa) calling attention to its dangerous nature and the need of vigilance in preventing its importation into Canada.



A plant of diseased potatoes as it appears when dug; showing a partially sound tuber with excrescenses caused by the fungus at the base; also showing six malformed tubers adhering to the plant. (After Güssow).

The Disease.—The organism causing the Wart Disease of Potato gains entrance to the tuber at the "eyes." In a mild attack the "eyes" turn gray and then black, but in more severe cases wrinkled warts or nodules appear on the surface. These are green or white at first, becoming brown or black, and may convert the tuber to a brownish black soft mass, with a putrefactive odor.

Reproduction.—There are two kinds of sporangia (spore cases)—Summer Sporangia and Winter or Resting Sporangia. **Summer Sporangia** are formed in the cells of the tuber in which the organism feeds. The spores from these spore cases are set free during the summer and may at once attack other tubers, thus spreading the disease. In late summer and autumn the **Winter** or **Resting Sporangia** are formed. These have the power of resisting winter conditions, and in spring they set free a large number of motile spores. If one of these spores reaches an " eye " it makes its way into the tissue and starts the disease. The Winter Sporangia retain their vitality for many years in the soil.



Microphotograph of a small diseased nodule showing numerous resting sporangia lying closely on the surface.

As Mr. Güssow has shown, the danger lies in the importation of potatoes from infested regions, as it is impossible to detect the disease in its early stages On his advice the importation of potatoes in Canada from regions known to have the Wart Disease is prohibited.

Control.—No satisfactory means of controlling this disease is known. Mr. Güssow states that under no circumstances should the unboiled or decayed potatoes of a diseased crop be given to pigs or other animals as food, nor should they be thrown on the manure pile. They should be burned or buried with unslaked lime.

Land that has borne potatoes with the Wart Disease should be thoroughly cleared of all diseased potatoes, and treated to a coating of unslaked lime at the rate of four or five tons per acre. Moreover, potatoes should not be planted on an infested field for seven or eight years. Under no circumstances should seed potatoes from a diseased crop be used.

WHITE-PINE BLISTER-RUST.—Cronartium ribicola.—This disease has also its origin in Europe where it has done a great deal of injury to White-Pine. It has been reported from various parts of the United States where it has been imported in nursery stock from Germany, and there is a danger that it may become established as a permanent pest and spread to the White-Pine plantations of Canada.

The Fungus.—Like many other rusts this fungus lives on two entirely different hosts—one stage on the White and allied 5-leaved pines; the other on the leaves of wild and cultivated Currants and Gooseberries. It cannot spread from pine to pine, but it can from currant or gooseberry to currant and gooseberry by means of the summer spores. Two kinds of spores are produced on the leaves

Pine-Currant Rust.

of currant and gooseberry—the **Summer** Spores, and the **Winter** Spores. When the Winter Spores are blown to white pines in the vicinity they may adhere to the bark of branches, and there germinate and penetrate the underlying tissues of the bark. In a year or two the disease manifests itself by an increased thickness at some point of the stem. In the spring fruiting bodies burst forth from beneath the bark, and liberate large numbers of yellow (spring) spores. These, when blown to leaves of currant or gooseberry, infect them and produce the characteristic disease on these plants.

Injury.—The injury to currants and gooseberries is not considered a serious matter, but when an infected White-Pine is planted the fungus lives in the bark until the tree dies. Most of the attacked trees die the first season that the fungus fruits. Old trees are not liable to be attacked, and "the great damage is caused by the dying of young pine trees in nurseries, plantations, and parks and those naturally reproduced in the forests." So great has the damage been in Europe that the growing of white pine has been discontinued in many countries.

Control.—The only practicable method of control of this disease is to plant White-Pine seedlings of American origin. In districts where the disease is already present all currants and gooseberries should be removed from the immediate neighborhood of the White-Pines. A rigid inspection should be made annually for all traces of disease and any diseased trees should be immediately destroyed.

APPLE TREE CANKERS.

W. Lochhead, Macdonald College.

In recent years considerable attention has been given to those appearances on apple trees commonly designated as **Cankers,** on account of the fact that but few orchards in the Province can be said to be free from them. Some of the best apple trees in many orchards have succumbed to the attacks of the canker, and the owners are already inquiring anxiously for information regarding the nature of this disease, and the best methods of combating it.

As a result of the observations and investigations carried on during the last few years it can now be definitely stated that there are several kinds of canker, each possessing its own peculiar canker, and each induced by a different cause.

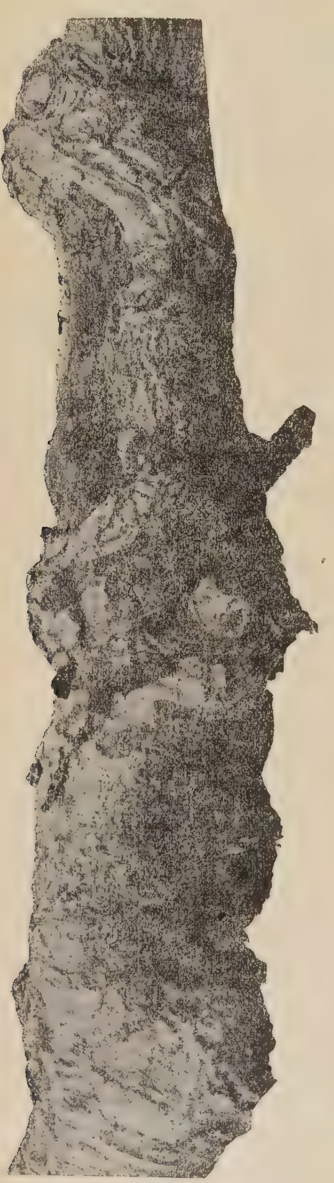
Cankers are wounds kept open by the action of some agency in spite of the attempts of the tissues to heal them. As a rule they are conspicuous, whenever they are present, either by the absence of bark, or by the abnormal roughness of the bark clinging closely to the adjacent tissues, or by a large mass of dead and disorganized wood.

Cankers may be grouped and discussed according to the agencies causing them:—1. Sun-scald and Sun-burn Canker; 2. Frost Canker; 3. Nectria Canker; 4. Bitter-rot Canker; 5. Black-rot Canker; 6. Woolly-Aphis Canker; 7. Blister Canker, and 8. Twig Blight Canker.

Sun-scald and Frost Canker.—Such a canker is nearly always observed on the south or south-west side of the tree. During warm days in winter the tissues on the sunny side of the trunk are warmed up and are incited to renewed activity. Such tissues always suffer from subsequent freezing by the loss of water from the cells. Afterwards they contract and crack open. Similar effects are produced by the action of very dry, cold winds, which cause the tissues to lose much water. The tissues destroyed in these ways become disorganized; the bark falls away from the wood, and saprophytic fungi effect an entrance before the wounds can be closed up by the rapid growth of the healthy tissue bordering on the wound.

European or Nectria Canker (Nectria ditissima).—This canker, which is the common one in orchards in Europe, has been identified for a certainty in but few localities in Canada and the United States. It is probable that it is in our Quebec orchards as it has been observed in New York State and Nova Scotia. (Fig. 1).

Massee describes this canker as being " a wound-parasite, its spores germinating in the first instance on some wounded surface, and from thence invading the healthy tissues. The bark is first attacked and destroyed, often cracking in a concentric manner; afterwards the wood is also destroyed, the canker often com-

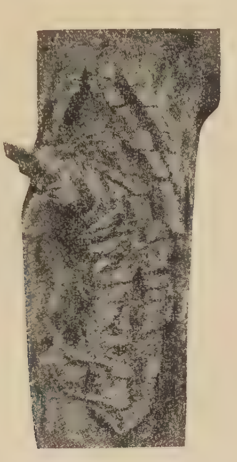


A limb diseased with Nectria Canker.
Note open wound with large callus edges.

Black Rot Canker on apple branch.
(For description see page 42.)

pletely girdling small branches. As a rule, a thickened, irregular margin of living bark forms round the wound, giving a ragged appearance to the parts attacked, and very characteristic of the disease." Spores (conidia) are borne in autumn on minute white cushions on the wound, and in spring ascospores are produced in small red perithecia, situated on the same cushions. Small white stromata appear in the fall and produce minute conidia (ovate-oblong, one-celled 7 x $3\frac{1}{2}^{u}$). In the following season pale stromata appear and produce larger conidia (sickle-shaped and pluri-septate—the Tubercularia stage). Perithecia develop later in dense papillate bright red clusters on the edges of the wound. Asci are cylindric, 8-spored; spores ovate oblong, 1-septate, 14 x 5-6^{u}.

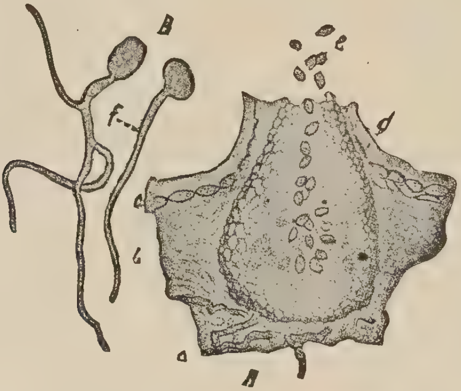
Bitter-Rot Canker (Glomerella rufomaculans).—This canker is very common in the orchards of Illinois and other central States. The relationship of this canker to the Bitter-Rot was discovered in 1902, when it was determined that the winter stage was passed on the cankers formed on the branches and often at the base of the old fruit-spurs. It was also proven that the main source of infection of the fruit was this winter and permanent stage of the disease in the canker.



Bitter Rot Canker (after Burrill).

This canker is most usually found on small branches, and starts from a bruise on the bark. "Growth takes place around the diseased area as it does about any wound, and there is found an irregular encircling rim of healing tissue about a dead and depressed, or sunken, usually elongated black patch, covered with dead bark." (Figs. 2 and 3). It injures fruit as well as branches. On the fruit it was long known as Gloeosporium fructigenum. The mycelium is present in the bark and cambium and the pustules break through the bark. The conidia are hyaline, ovate to oblong, 12/16 x $4/6^{u}$, and germinate readily. The perfect stage (ascus) develops on fruit that has wintered over on the ground. Perithecia develop in stromatic cushions. Asci are oblong-clavate, 55/70 x 9^u, and 8-spored Ascospores are curved, 12/22 x 4^u. infection of the fruit in many cases at least arises from the conidia on canker areas.

Black-Rot Canker (Sphaeropsis malorum). The Black-rot of apples is more or less common and well-known, but it is not so well-known that this same fungus produces cankers on the limbs of apple trees. The bark of affected areas first becomes discolored, then it becomes roughened and thickened. Sometimes the dead bark comes off, but usually the limb is girdled completely and killed. Infection takes place in spring through wounds, and the affected areas extend slowly as the fungus grows outward in all directions till midsummer, when a definite boundary forms between the dead and living bark. It is believed that sun-scald renders some varieties very susceptible to this canker (Figs. 4 and 5). Pycnidia appear through bark which produce oblong-elliptical brown spores, 22/32 x $10/14^u$.



Microscopic structure of the Black Rot fungus *a*. Section from a wintered specimen of crab apple showing, *a*. the dark-colored mycelial threads among the cells of the fruit, *b*: *d*.a thick-walled spore case (pycnidium), which has pushed through the epidermis, *c*. and is giving off dark-colored spores *e*, through the protruding mouth; *b*, mature spores germinating in water and giving rise to germ tubes, *f*. All highly magnified. (After Longyear.)

Twig-Blight Canker (Bacillus amylovorus).—Infection occurs usually at blossoming, and the disease extends down the twigs and branches, causing first a wilting, afterwards a blackening. Cankers are often formed at wounds made by pruning.

Blister Canker (Nummularia discreta) occurs in the Mississippi Valley and perhaps elsewhere. Its appearance on the large limbs is quite characteristic. The canker areas are mottled, sunken, cracked and charred. The blackened areas are dotted over with circular stromata. The mycelium penetrates both the bark and the wood. The stromata and fruit bodies begin to appear in late summer.

First of all conidia are formed; these are hyaline simple spores. Later, perithecia develop in the stromatic mass; these are flask-shaped and are sunk in the stroma. Asci are long and cylindrical, 160 x 13^u, 8-spored; ascospores are brown and spherical, 13 x 10^u.

In all cases of canker the smaller limbs should be removed and the large ones scraped and painted to prevent re-infection. Diseased fruit containing the summer stages should be buried or burned. Winter applications of white-wash, and summer applications of Bordeaux Mixture will be of great service in controlling these serious enemies of the orchard. Steps should be taken also to protect the south-west sides of the trunks from sun-scald injury, and to prevent careless bruising or abrasion of the bark.

This subject is worthy of more careful study.

THE ECONOMIC IMPORTANCE OF LAND BIRDS

W. P. Fraser, Macdonald College

Birds play an important part in their relation to agriculture. Whether they are beneficial or injurious depends largely on their food. The benefits they confer are the destruction of :—

Noxious or annoying insects ;
Injurious rodents, such as rats and mice ;
Weed seeds.

The beauty and charm they give to field and woodland may also be included here.

The chief injury done is by the destruction of :—
Fruit and grain ;
Useful wild birds and poultry ;
Beneficial insects.

The driving away of useful birds and the building of unsightly nests, as in the case of the English sparrow, may be included.

There is a tendency to magnify the harm done by birds. The loss of a few poultry caused by the raids of hawks is considered justification for their indiscriminate slaughter, while the fact that the majority of hawks prevent a much greater loss by the destruction of mice and insects is forgotten. The loss of fruit during its season is counted against the birds, while the insects destroyed during the rest of the year is scarcely reckoned in their favour.

Careful investigations have been carried on by the biologists of the United States Department of Agriculture in the field by observation, and in the laboratory by examination, of the stomachs of birds to determine their food habits, and the results have been published as bulletins of that Department. This paper is largely based on the information contained in these bulletins.

Gallinaceous Birds

The best known of these birds is the **Ruffed Grouse,** Bonasa umbellara togata, commonly known as the partridge. It feeds on fruit, buds, leaves and insects. They are of a considerable benefit on account of the number of insects destroyed, especially by the young. The eating of buds probably does no serious injury.

The **Spruce Grouse** or partridge inhabits the coniferous districts. It feeds for the most part on the leaves of the spruce. It is very tame, allowing the observer to approach within a few feet. It is a beautiful bird and adds much to the beauty of the dark coniferous forests of the north. It seems a pity that it cannot be spared to grace its woodland home, especially as its flesh is scarcely fit for food. Its food consists almost entirely of vegetable matter and does not affect agriculture.

Birds of Prey

The **Hawks,** Falconidae, are well fitted to prey on rodents and other birds. Their sharp strong claws and stout hooked bills are used for seizing and tearing their prey. They are also gifted with remarkably acute eyesight. They are usually regarded by the farmer as enemies and shot on sight because of the poultry taken by a few species. It is not easy to distinguish the different species of hawks, so the innocent suffer with the guilty. Only one or two of the hawks are positively injurious, living on useful birds and poultry ; the others are of such great value to the agriculturist that it would be much better to spare all than to destroy them indiscriminately.

Ranking first in economic importance is the **Marsh Hawk.** It may be recognized by its habit of flying low, back and forth over meadows and marshes, in search of mice and other small rodents. It destroys greater numbers of these pests than any other species and deserves protection.

Another useful hawk is the **Sparrow Hawk,** the smallest and handsomest of the hawks. It is rather common and lives largely on grasshoppers, other insects and mice.

The **Sharp-Shinned Hawk,** Accipiter velox, is the commonest hawk that may be classed as injurious. It feeds on birds and poultry. **Cooper's Hawk,** Accipiter Cooperii, is another species that lives almost entirely on wild birds and poultry. It does not seem to be common in this Province.

The **Owls** are among the most beneficial of all birds, doing little damage and conferring vast benefits upon the farmer. They are especially fitted for preying on rodents, as their eyesight is keenest in the dim light of the morning or evening when mice and other rodents are moving about. Their soft feathers permit of noiseless flight, which aids them in catching their prey. All are highly beneficial except the **Great Horned Owl,** which may take poultry and game birds.

The smaller owls also destroy large numbers of insects, as well as mice and smaller mammals.

Cuckoos

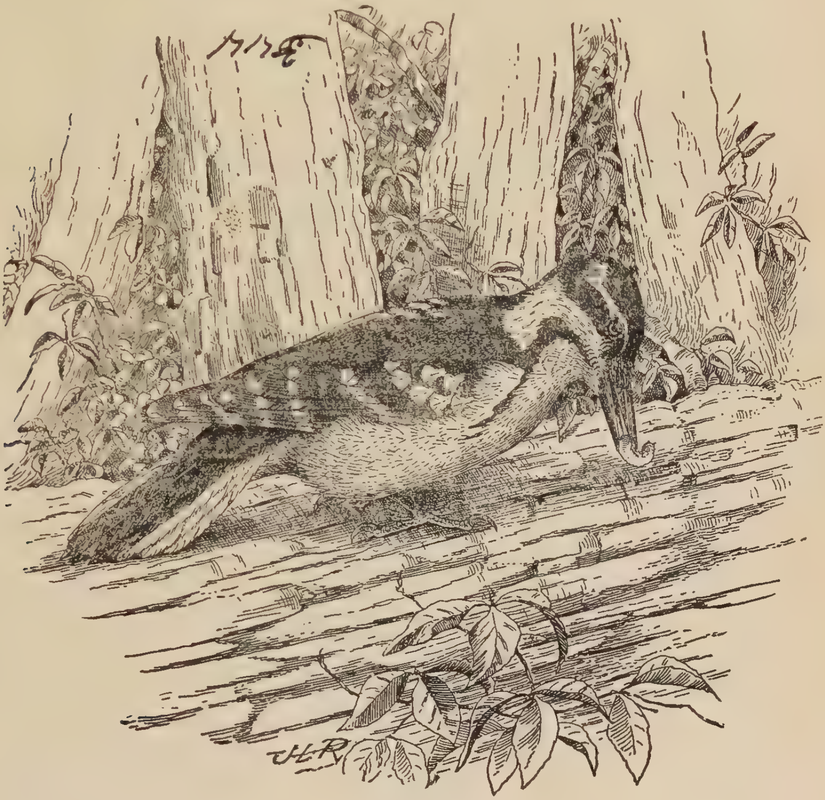
Yellow-billed cuckoo.

The **Cuckoos** are quiet shy birds living in groves or woods, frequently in orchards. Two species occur in this Province, the **Yellow-Billed Cuckoo,** Coccyzus americanus, and the **Black-Billed Cuckoo,** C. erythrothalmus. They live largely on insect food, which consists of beetles, grasshoppers, bugs, ants, flies and caterpillars. Caterpillars and grasshoppers constitute more than three-fourths of their food. All kinds of caterpillars are eaten, even the hairy and bristly species which are rejected by most other birds. They are especially valuable birds in an orchard. It has been estimated that a single cuckoo, during the time that it remains in its southern range, destroys about three thousand caterpillars. The writer has observed them, after eating caterpillars until satisfied, crushing them in its bill and then throwing them to the ground ; but this may not be a common practice.

The Woodpeckers

The **Woodpeckers** are well-known birds. They live largely in trees, from which they obtain the greater part of their food and in which they dig holes for their nests. They are well adapted for their arboreal life, as their toes are furnished with strong, sharp claws which assist them in clinging to an upright surface. The feathers of the tail are stiff and pointed and serve as a prop when the bird is digging out the insect larvae which forms its chief food. They live chiefly on the larvae of wood-boring beetles, and are efficient destroyers of these destructive forest pests. They also feed on ants and beetles and a small amount of vegetable matter, such as wild fruits. Unfortunately they are conspicuous and noisy and mostly unwary, so they are an easy mark for every passing gunner.

Downy Woodpecker, Dryobates pubescens. This is the smallest of our woodpeckers and is a common resident. The male has a scarlet band on the nape, which is absent in the female. It much resembles the downy woodpecker in appearance, but is a quieter bird and much smaller in size. It is one of the most useful of the family, destroying large numbers of wood-boring larvae and caterpillars, even feeding on larvae of the codling moth.

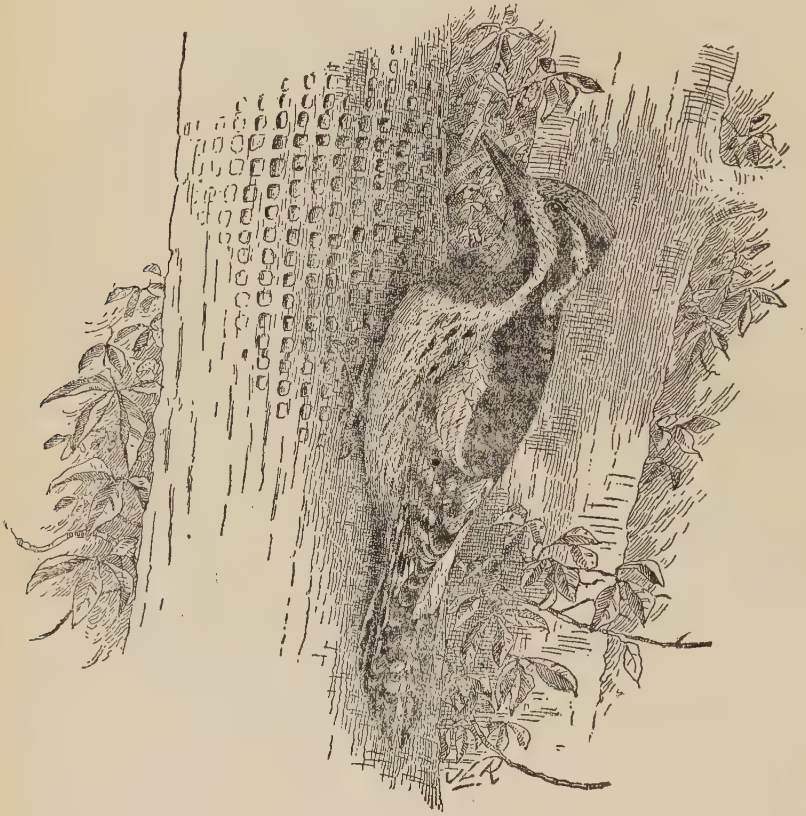


Hairy woodpecker.

Hairy Woodpecker, Dryobates villosus.—This is another common woodpecker much like the downy in appearance, but is a noisy, restless bird conspicuous by its loud calls and flights from tree to tree. It is also a resident and a valuable destroyer of forest insect pests.

Three-Toed Woodpecker, Picoides arcticus, P. americanus. These woodpeckers are valuable birds, but are rare. The Arctic three-toed woodpecker may be recognized by its shining black back and, in the male, an orange crown patch. The American three-toed is somewhat similar, but the back is barred with black and white.

Yellow-Bellied Sapsucker, Sphyrapicus varius.—This bird is a rather common summer resident. It lives chiefly on the cambium and sap of trees, drilling holes through the bark and drinking the sap. It does serious damage to forest trees. This species is doubtless responsible for the injury to trees that is sometimes ascribed to other woodpeckers. It may be recognized by its yellowish belly and the black patch on the breast. The crown is deep scarlet.



Yelfow-bellied woodpecker.

Red-Headed Woodpecker, Melanerpes erythrocephalus.—The conspicuous red head will distinguish this woodpecker. It is rather rare and not very valuable as a destroyer of forest pests, as it feeds on grain and berries during part of the year.

Pileated Woodpecker, Coephloeus pileatus.—This beautiful and conspicuous bird is a resident of deep forests. All its work helps to preserve the trees. It is rather rare and, unfortunately, is often shot on account of its conspicuous size and plumage.

Flicker, Colaptes auratus.—The flicker, also known as yellow hammer, high-hole or golden-shafted woodpecker, is a rather common summer resident. It often feeds on the ground and is especially fond of ants. On the whole it is a useful bird and, fortunately, is the most wary of the woodpeckers.

Goatsuckers, Swifts, etc.

This group is represented in Quebec by the **Whippoorwill**, Anstrostomus vociferus, a rather rare summer resident; the **Nighthawk,** Chordelies virginianus, a common resident; the **Chimney Swift,** Chaetura pelagica, and the **Hummingbird,** Trochilus colubris. The first three are exclusively insect feeders and highly useful. The hummingbird feeds on the nectar of flowers and small insects.

Perching Birds

Flycatchers, Tyrannidae.—The flycatchers are dull-colored birds with characteristic though unmusical notes. From some convenient perch they watch for insects and swoop into the air, catching them on the wing, and return to their perch. They also feed on wild fruit, but are largely insectiverous, beetles, grasshoppers and crickets being the insects usually taken. They destroy a large number of injurious insects, but also feed on the useful parasitic wasps. The latter, however, only forms a small part of their food. The following species are found in this Province :—

Kingbird, Tyrannus tyrannus.
Crested Flycatcher, Myiarchus crinitus.
Phoebe, Sayornis phoebe.
Olive-Sided Flycatcher, Nuttallornis borealis.
Wood Pewee, Myochanes virens.
Yellow-Bellied Flycatcher, Epidonax flaviventris.
Alder Flycatcher, Empidonax traillii alnorum.
Least Flycatcher, Epidonax minimus.

Larks

The horned larks are the only representatives of this family in North America. They frequent fields and never live in forests. Their food consists of weed seeds, insects and a small amount of grain. The **Horned Lark,** Otocoris alpestris, breeds in the north, coming south in the winter. The common summer resident in Quebec is the **Prairie Horned Lark,** Otocoris alpestris praticola.

Crows and Jays

Bluejay, Cyanocitta cristata.—Few birds are more conspicuous or better known than the bluejay. It has been blamed for robbing the nests of other birds and eating grain and fruit. Examinations of 292 stomachs by the biologist of the United States Department of Agriculture showed that its food consists of insects and spiders, but largely of grain seeds and fruit. The accusation of eating the eggs and young of birds was not sustained, and the conclusion was that the bluejay certainly does far more good than harm.

Canada Jay, Perisoreus canadensis.—The Canada jay lives in the northern wooded regions and its food habits probably does not affect the agriculturist. It is also known as the Whisky Jack.

Crow, Corvus brachyrhynchus.—The food of the crow consists of grain, fruit, insects, spiders, mice, the young of birds and their eggs, and much other vegetable and animal matter. The crow is generally regarded as an injurious bird and sometimes its depredations on grain fields are serious. It also destroys the young and eggs of many birds, though this is only a small item of its food. On the other hand, it feeds also on injurious insects as grasshoppers, May beetles, weevils, cutworms, and is also fond of the smaller vertebrates, such as young rabbits and mice. On the whole, where not too plentiful, the injury and good done by the crow about balance.

Northern Raven, Corvus corax principalis.—The raven differs from the crow in its much greater size and in the presence of long pointed feathers on the throat. Its food habits do not seem to have been studied, but they are probably much like those of the crow.

Blackbirds, Orioles, etc.

The **Bobolink,** Delachonyx oryzivorus, is a valuable bird during the summer season in the north, feeding on weevils, caterpillars and grasshoppers, but is very destructive to the rice crop in the southern United States during its migrations.

The **Cowbird**, Molothrus ater, has often been condemned because of its habit of laying its eggs in the nests of other birds, but its food habits make it a valuable bird. About 50 per cent. of its food consists of the seeds of noxious weeds, 20 per cent. of harmful or annoying insects, and about 16 per cent. of grain, part of which is probably waste. It does not feed on fruit.

The **Redwinged Blackbird,** Agelaius phoeniceus, lives chiefly on noxious insects and weed seeds. It also feeds on grain, but the service rendered by its destruction of insects and seeds far outweighs the damage to grain fields.

Bronzed Grackle, Crow Blackbird, Quiscalus quiscala aeneus.—This bird is rather common, and in some places does considerable damage to grain fields. On the other hand, it destroys a large number of noxious insects, and in this way does much good. They have a tendency to increase rapidly in some sections and often are locally injurious.

The **Rusty Blackbird,** Euphagus carolinus, is less common than the grackle and is on the whole a useful bird.

The **Meadow Lark,** Sturnella magna, and the **Baltimore Oriole,** Icterus galbula, are common and well-known birds. The former lives in the fields and feeds largely on grasshoppers, crickets, beetles, bugs, caterpillars and vegetable matter. From the study of their stomachs it is estimated that a single bird destroys about fifteen hundred grasshoppers a month during the season while the insects are plentiful. The oriole supplements the work of the meadow lark, feeding chiefly on insects or their larvae that infest trees, destroying immense numbers of caterpillars, grasshoppers, bugs and noxious beetles.

Finches, Sparrows, etc.

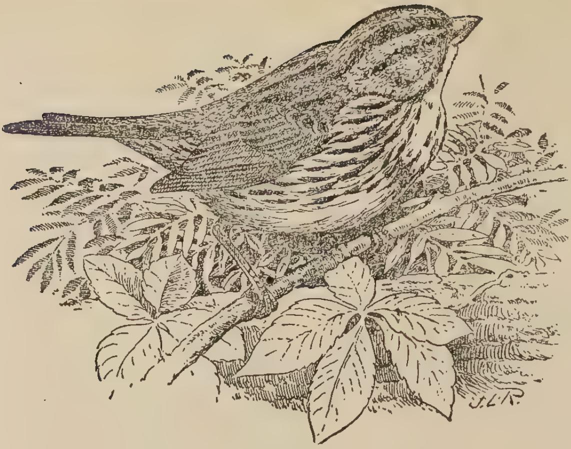
The sparrow family, Fringillidae, differ much in appearance and habit, but generally have stout, strong bills fitted for crushing seeds.

The **Brown-Streaked Sparrows,** which are often called greybirds, usually inhabit fields or plains, and their dull coloring affords them protection from birds of prey. Those that live in trees are more brightly colored.

Living chiefly on seeds, the sparrows are not so migratory as insect-eating birds like the warblers. In this Province the majority migrate, but they come early in the spring and remain late in the fall. A few of the sparrows are winter visitants, coming from their northern summer homes in the fall and remaining during the winter, returning in early spring.

They live chiefly on seeds, insects and fruit. Many of the seeds eaten are those of noxious weeds, and as seeds are their chief food, they are unrivalled as weed destroyers. The sparrows also feed on insects, about 25 per cent. of their food consisting of these pests. The nestlings are almost entirely insectiverous, and during the nesting period countless numbers of insects are used for feeding their young.

Of the brown-streaked sparrows the **Song Sparrow,** Melospiza cineria melodia, is perhaps the most common and best known. It comes early in the spring, about the last of March, and its bright, cheery song may be heard in all kinds of weather.



Song sparrow (*Melospiza fasciata.*)

It may be recognized by its streaked breast with a dark blotch in the centre. The crown of the head is brown with a grey line through the centre and a greyish line over the eye. It lives mostly on the seeds of weeds, but in July takes a good deal of wild fruit. It also feeds on grasshoppers, moths and weevils.

The **Vesper Sparrow,** Poocoetes graminis, is common in fields. It may be known by its rather dull, unstreaked head and the white outer tail feathers which may be seen when the bird is flushed. Its food is much like that of the song sparrow. The **Chipping Sparrow,** Spizella socialis, is common in gardens and lawns and may be distinguished by its unstreaked breast and reddish-brown crown. Other common brown-streaked sparrows are, the **Savanna**, Passerculus sandwichensis savanna, which frequents fields ; the **White-Throated Sparrow,** Zonotrichia albicollis, a bird of the woodland, and the **Swamp Sparrrow,** Melospiza georgiana. Much less common than those are the **Acadian Sharp-Tailed Sparrow,** Ammodramus nelsoni subvirgatus, found on the marshes of the eastern part of the Province, and the **Field Sparrow,** Spizella pusilla. The **Tree Sparrow** is a common winter visitant, and during the spring and fall migrations the **Fox Sparrow,** Passerella iliaca, and the **White-Crowned Sparrow,** Zonotrichia lecophrys, are sometimes not rare.

The **Junco,** Junco hyemalis, is very common. It may be recognized by the upper parts being slate colored and the white outer tail feathers conspicuous when the bird is on the wing. Its effect on agricultural land is an unmixed benefit, as it destroys the seeds of weeds and does no real harm.

Other common birds belonging to the sparrow family are, the **Purple Finch,** Carpodacus purpureus ; the **Goldfinch,** Astragalinus tristis, and the **Rose-Breasted Grosbeak,** Habia ludoviciana.

Four common seed-eating birds.
1. Junco ; 2. White throated Sparrow ; 3. Fox Sparrow ; 4. Tree Sparrow.
(From 1898 Year Book Dep. Ag. U.S.A.)

The Swallows

The swallows are insectivorous birds, taking their food on the wing. They destroy a few of the useful parasite wasps, but the greater part consists of injurious species: beetles, ants and flies are the forms most commonly taken. Five species of the swallows occur in Quebec, as follows :—

Purple Martin, Progne subis.
Cliff Swallow, Petrochelidon lunifrons.
Barn Swallow, Hirundo erythrogaster.
Tree Swallow, Iridoprocne bicolor.
Bank Swallow, Riparia riparia.

The **Waxwings** live chiefly on fruit and the **Vireos** chiefly on insects. All the vireos are useful protectors of forest and fruit trees, as they are for the most part arboreal, gleaning their food from the surfaces of the leaves and from the bark. They are rather slow in their movements, not flitting about like the warblers. The **Red-Eyed Vireo** is by far the most common species in this Province.

The Warblers

The warblers are small birds scarcely known except to the bird student, and no greater pleasure awaits him in this study than making the acquaintance of these brilliantly colored inhabitants of the woodland. They feed almost entirely on insects, and thus only remain for a few summer months while insects are plentiful. Many of them winter in South America.

The majority capture their insect food flitting from branch to branch, some capture their food on the wing, while a few feed on the ground. They destroy immense quantities of the smaller insects. No better lesson on the value of these birds as insect destroyers could be obtained than to watch them feeding for some time. One observer estimates that a single warbler caught from forty to fifty insects per minute, or three thousand in an hour. Their food includes also a small number of useful parasitic wasps. Twenty-five species have been reported from Quebec, of these fifteen are rather common.

The **Catbird,** Galeoscoptes carolinensis, and the **Brown Thrasher,** Toxostoma rufum, belong to the family that includes the wrens. Both of these birds live on fruit and insects, the thrasher is especially fond of the May-beetle.

The **Brown Creeper,** Certhia familiaris americana, the **Nuthatches** and the **Chickadees** are gleaners of tree-trunk insects and their eggs. The eating of insect eggs is a characteristic habit of the chickadee, and thus makes the bird one of the most effective destroyers of insect pests. Between 200 and 300 eggs of the fall canker worm have been found in the stomach of a chickadee, and 450 eggs of plant lice in that of another. They are of especial value in an orchard. The **Kinglets** are also useful birds, resembling the chickadees in their habits.

The Thrushes

The thrushes are migratory birds, two species of which the **Robin,** Planestictus migratorius migratorius, and the **Bluebird,** Sialia sialis sialia, are well known. The others are found in wooded regions and are unknown except to the lover of birds or their songs. Both the robin and the bluebird destroy many noxious insects that infest the cultivated fields. The robin also is fond of fruit, as is well known, but pays well for the cherries taken by the insect pests that it devours.

Of the woodland thrushes, the **Hermit Thrush** is the best known and the most common. All are noted songsters, but the hermit in purity, " in tranquil clearness of tone and exalted serenity of expression, goes beyond any wood music we ever hear."

DECAY IN HARVESTED APPLES AND ITS CONTROL

P. I. Bryce, Macdonald College

The question has suggested itself, " Why should we be interested in the fungous diseases or rots of harvested apples ? "

Much attention and a great outlay of money are being devoted to the suppression of diseases of the apple during the growing season. The primary control of disease in the field must ever be the chief interest of the orchardist ; but I shall try to show that something may be done after the apple is ripened and picked to prevent its decay and extend its season. A lack of adequate and suitable supplies in the winter months is sufficient excuse for the proposition I suggest. This shortage is due largely to inability to preserve an abundant crop, much of which is sacrificed at low prices in the fall, and a large percentage lost by preventable decay during packing and shipping, or in storage. Should we be paying twenty-five cents a dozen for apples for which the grower received last autumn one dollar per barrel?

The apples we are buying in this, the late winter season, are of the main Canadian crop, comprising only early and late winter varieties. These also supply the major part of the growing trade with the Western Provinces, and the exports to Great Britain, amounting, in 1910, to 1,523,901 barrels, valued at $4,184,873.

In these notes are discussed some fungous diseases affecting stored apples, and the means of preventing their occurrence and development. Most of the paper is based on G. T. Powell's bulletin 78, U. S. Bureau of Plant Industry, " The Apple in Cold Storage," while publications of the Department of Agriculture, Ottawa, were consulted. Full descriptions of the fungous diseases are given in Duggar.

A few of the many troubles are : **The Apple Scab**, Venturia pomi (Fr.) Wint ; the **Pink Mould,** which grows on scab, Cephalothecium roseum Cda ; **Brown or Bitter Rot,** Glomerella rufomaculans (Berk.) Spaulding and von Schrenk ; **Black Rot,** Sphaeropsis malorum Pk.; and **Soft Rot,** or common blue mould, Penicillium glaucum. All these diseases occur in Quebec Province, but to what extent is not yet known.

Apple Scab occurs widely in hot, moist summers, and is probably the most widely known fungous pest. Not only destructive by making fruit worthless or of poor quality, it is followed by other moulds and decays. Growth of scab itself on the fruit may continue after picking, if apples are not kept at low temperatures.

In hot and moist summers Scab may destroy or reduce in value 25 to 30 per cent. of the crop. There are two stages of the disease. One on the fruit, twigs, and leaves in spring and summer causes deformations in some varieties of fruit while the leaves are spotted or even curled up. Wind spores, or conidiospores, spread the disease, but it winters on fallen leaves where the cup-spores develop and are shed in the spring.

The Pink Rot or mould, Cephalothecium roseum, which occasionally develops on the scab spots, does most damage to fruit after storage, and is especially to be feared in R. I. Greenings.

The Bitter Rot, Glomerella rufomaculans, is thought to be the most serious apple disease of the United States, where an epidemic in 1900 caused an estimated loss of ten million dollars. The disease causes cankers on twigs and limbs, described as sunken spots with broken or cracked bark. Spores from the cankers infect the early diseased fruit, which then shows spreading lines of small brown spots radiating from a centre. Pustules on the spots produce wind-borne spores, spreading the rot to other fruit. There is also a perfect or ascus stage. The winter may be spent in windfalls on the ground, but early summer infection is supposed to be spread mainly from the cankers on the tree. Duggar says : " Bitter rot can spread with alarming rapidity, causing enormous devastation within a week."

Black Rot and Canker of the Apple, or New York Apple Canker, Sphaeropsis malorum, was reported to this Society as being present in 1909, and occasionally in 1910. It is characterized at first by a brown spot spreading over the whole fruit. On the tree occur cankers or depressed withered spots upon the large limbs. These are not always severe, but they may cause large wounds, girdle the affected branch, and so kill it. Standard winter varieties are susceptible, such as Baldwin, Wagener, Greening and King. The vegetative part of the fungus is brownish, and the spore-bearing organs burst through the outer tissues as a pustule. The spores are said to live as long as a year.

Though not classed as a disease, being rather a feeder on dead tissues, **Soft Rot,** or Common Blue Mould, Penicillium glaucum, is a most destructive fungus in stored apples. Entering the fruit by some wound, bruise or worm-hole, the mycelium grows over the tissues and dissolves them, forming a greenish-blue mat. Conidia or wind-spores are developed in chains or branched organs, while cup—or ascospores—may also occur. Fruit in closed barrels is apt to suffer heavily while awaiting re-packing, if kept at all warm. By storing no over-ripe or injured fruit, Blue Mould can be avoided in part. When it begins it makes rapid progress, even at low temperatures.

While we have thus numerous diseases in stored apples, up to the present the chief means of control is storage at low temperatures ; or, if the stock is to be shipped at once to the market in iced cars prior refrigeration by the circulation of cold-air currents is most desirable. This process, sometimes called pre-cooling, has been experimented with and shown to be a success. The object thus achieved is to remove the warm conditions under which decay thrives, and to prevent the fruiting of fungi, with subsequent spread of the disease.

To insure quality, for fruit does not improve in market grade in cold storage, careful packing, with rigid exclusion of diseased, bruised and wormy fruit, is most essential. If the fruit can be placed in really cold storage it need not, and should not, be packed till mature and well coloured. Fancy fruit may be picked as it ripens, as many specialists already do. Packing and grading are best done as soon as the fruit is picked. The prevalent practice of repacking in frost-proof warehouses owned by buyers results in heavy losses from rot in the delay before repacking, and from bruising of the ripened and softened fruit. According to the Cold Storage Commissioner, " The shrinkage in repacking is a direct loss amounting to a very large sum." Delay in cooling was observed last fall to result in a loss of about sixty barrels of Russets out of 150 stored for some three weeks before repacking. This fruit was held at out-door temperatures in a frost-proof storage in tightly closed barrels, just as picked from the tree.

Early, delicate or very fancy fruit may be packed best in small, easily-ventilated packages. Prof. Reynolds, Ontario Agricultural College, has shown that apples packed in fifty-pound boxes cooled more quickly than similar fruit in barrel quantities. G. T. Powell states, " It is of the greatest importance that the fruit be stored immediately after picking, if the weather be warm, in order to insure it against the unusual development of the fungous rots." He finds that " A delay of two weeks before storing (in the cold) caused a loss from decay or scald of from forty to seventy per cent." One has noted that fruit, notably Fameuse, picked while wet, and " headed up " in the barrels still damp, developed a disease called by some packers " ink spot." The bright red coat of the fruit must be culled out. Packages, however, in storage, should be well closed to avoid wilting by evaporation.

For the purposes of the average householder and small orchard owner the winter climate of this Province affords proper temperatures for storage in frost-proof cellars, root-houses, or preferably in a dry fruit room above ground level. Proper ventilation at night in the fall months should enable the small buyer to take advantage of the lower price and larger choice of rot-free fruit in the autumn. Only the best grades should be purchased.

The growers for commercial purposes should keep their crop in low temperatures under control if the late winter and spring market is to be supplied. They will be able, by rapid cooling and storage at a temperature of 31 to 33 degrees

Fahrenheit, or as near as possible to 32 degrees, to market fruit in first-class condition, free from rot, in April, May, or even June. Only prime apples will keep so long, and while in storage must be under observation so that they do not overripen in the barrel.

Many of the fungus decays have their progress quite arrested at 32 degrees F., though black mould and soft rot, or blue mould, keep on growing slowly. Cold storage fruit when properly ripened keeps better than if stored before real maturity. Ripe fruit is notably less hurt by brown scald in which the natural ferments are supposed to cause the discoloration.

Powell shows by the following table that wrapping fruit helps to preserve it against decay. Wrapped and unwrapped fruit were kept at 31 to 32 degrees F. from the time it matured till the twenty-ninth of April following.

Amount of Decay Noted on April 29th of Fruit Stored Previous Fall in Bushel Packages :

Variety	Wrapped in Newspaper, per cent. decay	Unwrapped per cent. decay
McIntosh Red (a)	7.7	15.0
McIntosh Red (b)	19.7	32.0
Northern Spy	5.6	52.0
Wagener	38.0	63.0
Wealthy	42.0	60.0

It should then be worth while to remember in regard to our standard fruit, the apple, that fungous diseases may be arrested or prevented by rapid cooling and storage at freezing point, or thereabouts ; that it should be matured and properly colored, though not overgrown, to give the best keeping and market quality ; that the best fruit is got by picking over the tree several times ; that the best of grading and packing is desirable ; that delay before storing, or allowing apples to heat, hastens rotting ; that repacking is to be avoided ; and that fruit keeps best in small closed packages where it cools quickly. Lastly, a fruit wrapper retards ripening, preserves color and firmness, and prevents the spread of fungous spores.

THE NEW YORK PLUM SCALE (Lecanium cerasifex)

J. C. Chapais, St. Denis-en-bas

SUMMARY :—Historical notice.—Classification.—Summary description—Difference in the appearance of female and male scales.—Mating and egg laying.—Hatching and first moves of the young scales.—Fall migration and hibernation.—How to combat the Plum Scale.

Historical notice.—If I have thought of writing a paper on the New York Plum Scale it is on account of the fact that Mr. Alfred Lebel, of St. Denis, Kamouraska Co., P.Q., appointed by the Quebec Department of Agriculture last year (1911) to make a thorough inspection of the orchards of the members of the Kamouraska County Horticultural Society, has discovered that insect in four of those orchards, in three different parishes. Some of those who will read this paper will find nothing new in what I say about the **Lecanium cerasifex,** for it is known since many years in Europe and America, and, more specially, since 1894, in Canada. But, as it is the first time, I think, that its presence has been observed in Eastern Quebec, I think it is a good thing to draw upon it the attention of the Quebec fruit growers, so as to prevent its spreading in their orchards.

This pest seems to have been noticed in Vermont in 1866, in Missouri and New York in 1893. It is probably the same scale as the European scale that was named **Lecanium corni** by Bouché and is known in Europe since 1844. What may have been its first appearance in Canada is mentioned by Fletcher as having occurred in Simcoe County, Ont., in 1894. It is said that it is the same insect as **Eulecanium prunastii,** a cosmopolitan species, says the Century Cyclopedia, which occurs in Europe, Japan and the United States.

Classification.—Those who have made a special study of the Plum Scale don't seem to be very sure of its real scientific name. But, after having read all that has been said about it by Beach, Howard, Sanders, Jones, Bouché, Cockerell, Fitch, Walsh, and Crane, who have respectively called it : **Lecanium corni, L. Inglandi,** Bouché ; **L. Inglandisfex, L. cerasifex,** Fitch ; **L. rugosum,** Cockerell ; **L. Americanum,** Crane ; **European fruit Lecanium,** Sanders ; **L. prumastii,** Howard ;—in presence of that variety of names, I adopt the opinion of our late federal entomologist, Fletcher, who writes in his 1895 report, that he

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(1) From the Greek **LEKANE,** a dish, pot, pan—allusion to the shape of the scale.

thinks it a good plan to keep its name **Lecanium cerasifex,** under which it was mentioned first in the old horticultural publications. Then, here is how is classified that insect :—

The New York Plum Scale belongs to the **Arthropoda** phylum, the **Insect** class, the **Hemiptera** order, the **Coccidae** family, the **Lecanina** sub-family, the **Lecanium** genus and the **Lecanium cerasifex** species, being called in French **Le Kermis du Prunier.**

Summary Description.—I have gathered what I am going to say about the Plum Scale mostly from data given by Slingerland, Fletcher and Jones. On the trees infested by that insect we find, in all seasons of the year, brown scales one-sixth of an inch long, one-eighth of an inch wide and one-twelfth of an inch thick, and an abundance, at some periods, of much smaller ones. The larger brown dead scale or shell of the mature female insect is present on the tree during the whole year, thus enabling fruit growers to tell at any time whether the pest is in their orchards or not. They are very conspicuous and may be easily found. They remind one of small halved peas coloured dark brown and stuck on the branches. Beneath the dead scales the bark presents a white scar of the exact shape of the outline of the scale.

In May and June, in Quebec, the living female insects resemble the dead scales but they are soft to the touch and often striped with yellow. In July, after egg laying has ceased, they become firm and smoother, lose their yellow marking and are then simply a dark brown shell. If this shell be then turned over it will be found full of the minute white eggs of the pest.

In ordinary scales, such as the oyster shell bark scale and the San Jose scale, the body is protected by a wax covering made up from secretions and the molted skins of the larvae, but in the Plum scale the horny covering of the full grown scale is a part of the body of the insect. The older scales are shiny, oval, convex, and often covered with a mealy pruinous deposit.

After about August 1st, in Quebec, the dead scales contain nothing but a white dust consisting of the empty egg shells, and are no longer a menace to the tree. They occur most numerously on the under sides of the branches of the preceding one or two years growth.

When the large shells are found, closely examine the bark and their vicinity for a minute, very flat, spindle-shaped, dark brown scales. It is this stage of the insect that now portends danger to the orchards. They are to be found snugly tucked away into almost every crevice on the trees from the trunk near the ground to the topmost twig.

About May 1st, or even earlier, these little scales begin to move about on the tree; they are seeking a suitable place to establish themselves. This they usually do on the under sides of the smaller branches. Once established, most of them, probably, never move from the spot. Each scale inserts its little beak or sucking organ into the bark for nearly two months, each insect's pump is kept constantly at work, drawing out the sap. The result is that they increase in size remarkably fast and grow to the dimensions mentioned above for the larger scales. Those attaining that size are all females.

Difference in the appearance of female and male scales. We must now mention the difference of appearance between the male and female scales. Many of the little scales do not grow into the large conspicuous scales. But, after feeding for a short time, their skin is cast off and the insect forms a thin, delicate semi-transparent, whitish, ribbed scale or shell over the pupae. Beneath this cast skin, the male insect develops. It is very delicate in structure and is provided with two large whitish wings and two long white filaments which project from the end of the insect's abdomen. The male scale insect is thus much smaller, flatter, more elongated, and is of a whitish colour. They often occur in considerable numbers among the large brown female scales, in June and July. They are rarely seen after July. The males doubtless emerge in May or June, but probably live only long enough to meet with the then matured females.

Mating and egg-laying. The mating is performed from about May 15th to June 15th or somewhat later on, the female being at that time full grown. Egg-laying begins then immediately and lasts during seven or ten days. The female lays her eggs under her own body, and what was a large fleshy soft-bodied female becomes, when the task is performed, only a thin hard shell closely adhering to the branch and containing a mass of embryonic life in the form of minute white eggs. The number of these laid by a single female is enormous, reaching into the thousands.

Hatching and first moves of the young scales. Hatching takes place in June and July and the young scales begin to move and go into the leaves and fruit stems where they at once begin to suck the sap. Their presence soon tells upon the vigour and health of the trees.

But the most noticeable indication of the presence of the pest is caused by the clear, sweet, sticky liquid known as honey-dew which the little scales secrete in July and August. A black fungus always accompanies this honey-dew, growing in and spreading all through it, and the fluid is secreted in such quantities as to literally cover the whole tree. The consequence is that badly infected trees present a disgusting, black appearance as if coated with a thin, sticky, smutty substance. The fruit is also injured and dwarfed.

Fall migration and hibernation. By the month of September, the young scales which have then turned brown in colour move to the undersides of the branches of the tree where they feed during two months, and are found sometimes numerous enough to form two or three layers of scales on the bark. They also crawl by thousands into any sheltering crevices on large or small limbs or even on the trunk of the tree. They spend the winter there without feeding. There is only one brood in the year.

How to combat the scale. I find that Slingerland, Fletcher and Jones agree upon the following treatment to get rid of the plum scale. The remedy to apply is nothing but kerosene emulsion prepared for use in the usual well known quantities, one-half pound of common home-made soap, one gallon of soft boiling water and two gallons of kerosene. Apply it, the first time, diluted in four parts of soft water to one of the emulsion, about a fortnight before buds open, and a second time ten days after the first, before buds open. Make a third application with the emulsion diluted in eight parts of water to one of emulsion, when the young scales are moving from their mother, by the beginning of July. Then a fourth application is made with the same emulsion diluted in four parts of water to one of emulsion after November 1st.

A thing to be borne in mind is that the trees must be thoroughly drenched by the spraying, every time it is resorted to.

I owe many thanks to Messrs. L. O. Howard, Entomologist, United States Department of Agriculture, Washington, and W. H. Jordan, Director, New York State Experiment Station, Geneva, for much information received from them about the **Lecanium cerasifex.**

BEES AS FRIENDS OF THE AGRICULTURIST

(Synopsis of an address given before the Macdonald Apiary Club.)

W. Lochhead, Macdonald College.

1. The Statement—Bees as the Friends of the Agriculturist. This statement must appear to all of us here a self-evident truth. Evidences lie everywhere about us—in the garden, the orchard, and the fields. Occasionally, however, we are asked to provide definite proof of the value of bees in the setting of fruit or in the production of clover seed. We are told that it is very well to tell people that bees are necessary in the orchard, but more is required than a mere statement. Definite proof ought to be forthcoming if the public is to be convinced. My purpose, then, is to produce the proofs or evidences that bees are necessary to the farmer and the fruit-grower.

2. Kinds of Evidence. In this matter, as in others, there are two kinds of evidence, *circumstantial* or *indirect* evidence, and *direct* evidence. Circumstantial evidence may be strong or weak according to the intensity of the light it throws on the mystery. If it offers the only satisfactory explanation of the facts of the case it is frequently as valuable as direct observational evidence. If it can be shown that the blossoms of apples and clovers, for example, are so constructed that they require insects to pollinate them; and if their colours and sweets attract bees anp wasps, we may feel certain that such indirect evidences are of much weight. On the other hand, if it can be shown that the blossoms of the plants protected from insect visits set no fruit or seed; or if orchards and fields, when unvisited by bees and wasps, or when visited by few, produce but little fruit or seed, these would be direct evidences of the value of such insects.

3. Indirect Evidences. That bees visit flowers for the sake of the nectar and pollen has been known for thousands of years, but the part played by bees in connection with the fertilization of flowers, and the adaptation of flowers to insects are of recent discovery. To Kolreuter, Gartner, Sprengel and Darwin we owe much for their investigations on the inter-relations between insects and flowers. To Darwin especially we are indebted for the discovery that as a rule continued self-fertilization is disadvantageous to plants. The results of his experiments led him to make his famous remark, " Nature abhors perpetual self-fertilization." The advantages of cross-fertilization over self-fertilization were shown by the difference in height, weight, constitutional vigor and fertility of the offspring, and in the number of seeds produced.

Moreover, Darwin showed that certain flowers are dependent for fertilization on the transference of pollen from other plants of the same kind.

Observations reveal the fact that cross-pollination is accomplished mainly by two agencies, the wind and insects. Wind-pollinated flowers have dry, powdery pollen, feathery stigmas (as a rule), inconspicuous, regular corollas, and no odor or nectar. Insect-pollinated flowers, on the other hand, have sticky pollen, showy, often bright colored and irregular corollas, nectar, and attractive odors.

A close study of plants reveals the fact that a very large number are modified in some form to secure cross-pollination. The principal devices adopted are:

(1) **Diclinism,** or the separation of the stamens and pistils on different flowers, on the same plant or on different plants;

(2) **Dichogamy,** the difference in time of maturity of stamens and pistil on the same flower;

(3) **Special contrivances** in the flower whereby cross-pollination is favored; and

(4) **Self-sterility,** or the inability of a flower to set fruit with its own pollen.

In the apple and pear there is a slight difference in date of maturity of stamens and pistil, the pistil maturing first. In the clovers, as we shall see, there is a special structural contrivance which enables foreign pollen to reach the stigma first. Besides, these blossoms contain abundant nectar. Self-sterility is common in orchard varieties, particularly of pears, plums, and grapes; and the list is fairly large. This fact alone shows the important part played by cross-pollination.

When, therefore, the flora of a country is closely studied it is found that insect cross-pollinated flowers can be told, even at a glance, in many instances. They always show the associated characters which I have already indicated, viz.: colored corolla, sticky pollen not capable of being wind-blown, and the presence of nectar and often of odors. Frequently, besides, they have some special device which favors cross-pollination.

Now, orchard blossoms and clover blossoms possess all the characteristics of insect cross-pollinated flowers, and if it is found that bees are the main insect visitors, the evidence is convincing that bees are the main agents in the production of fruit and the setting of seed.

The Apple Blossom. The flower of the apple is perfect, i.e., has both stamens and pistil. The calyx is urn-shaped, upon which rests the corolla with five rose-colored petals. There are numerous erect stamens. At first they are crowded together in the middle of the flower, and the unripe pollen sacs (anthers) are on the same level as, or a little below, the five stigmas which mature earlier. Anthesis (opening of the sacs) begins about two days after the opening of the buds, and lasts from five to six days. The outer anthers open before the inner. Self-pollination may occur in those varieties where the stamens keep opening for some time, and at the fading of the flower when the styles bend outward among the stamens.

Pear Blossoms. The petals are white and attractive as in the apple. Anthesis lasts from seven to eight days. On the opening of the flowers the central stigmas are already mature, and the styles stand erect and above the unripe stamens which bend inward and guard the passage to the nectar. As a result, the insect alights on the stigma and effects cross-pollination. This protogynous stage lasts from two to four days.

It will be seen, therefore, that cross-pollination is absolutely essential. Although some varieties are fertile with their own pollen, yet many require to be pollinated by another variety. Nectar is secreted copiously in the cup-shaped disk, which attracts bees and other insects. Pollen is transported from tree to tree by bees and other insects, and not by the wind.

Red Clover Blossom. The blossoms of Red Clover are irregular and aggregated into spherical heads. The corolla is composed of five petals united at the base, an upper large petal (the standard), two side petals (the wings), and two lower petals united in a keel-shaped structure (the keel). The "keel" contains the ten stamens with nine filaments united to form a tube, and the pistil with a long style. The stigma projects above the anthers to some extent. The nectar is found at the base of the stamen tube at their junction with the claws of the petals.

When a bumble bee lights on a blossom its weight depresses the interlocked wings and keel, and causes the stigmas and anthers to protrude beyond the apex of the keel and strike the under surface of its body which is covered with pollen brought from another flower. On account of the greater length of the style, the stigma strikes the body of the bee before the anthers do, thus effecting cross-pollination. Self-pollination, it is true, must often occur, but it is ineffective, as shown by Darwin and others.

To reach the nectar, insect visitors must have a beak 9-10 mm. long, but "any insect sufficiently heavy to press down the keel can pollinate the flower." The bumble bees have long beaks and are able to get the nectar and at the same time pollinate the stigmas.

White Clover. The flowers are white or reddish, and have a sweet smell. The stigma projects beyond the anthers and bees alone are able to work the mechanism properly so as regularly to effect cross-pollination. The wings and keel move together. Short-tongued bees are unable to reach the nectar, but honey bees are responsible for most of the pollination.

The Plum Blossom. The white flowers and nectar are attractive to insects. The Americana flowers are slightly protogynous, so that when they open they are ready to receive pollen. The Domestica flowers are more protogynous than the Americana flowers, so that they are more likely to be cross-pollinated. Infertility of pollen prevents fertilization even when self-pollination occurs.

Raspberry and Blackberry Blossoms. These blossoms have white petals and abundance of nectar, but those of the blackberry are more attractive. The stigma is receptive before the stamens mature, so that cross-pollination is facilitated. In both species, honey bees are the main pollinators.

Gooseberry and Currant Blossoms. These secrete nectar and are visited by honey and bumble bees. In one of these species the flowers are dioecious; that is, the staminate and pistillate flowers are on different plants. In the rest, the relative positions of stamens and stigmas secure cross-pollination.

The Strawberry Blossoms. Inasmuch as many of the cultivated varieties of the cultivated strawberry are staminate and pistillate, cross-pollination is absolutely essential to fertilization. " Nectar is secreted by the receptacle at the base of the filaments next to the outer row of pistils." Honey bees and short-tongued bees are the main pollinators.

4. Direct Evidences. The direct evidences obtained by means of experiments and observations show clearly that bees are very important factors in the pollination of orchard fruits and the various species of clovers.

The Apple. Waite, of Washington, covered many blossoms with gauze netting, and out of 2,586 only three apples set fruit. " Of these the Baldwin, Spitzenburg, and Fameuse set some fruit." Further experiments showed that even the Baldwin, which is often self-fertile, gave much better results (4 times) when cross-pollinated. The Greening, Talman Sweet, Spitzenburg, and Twenty Ounce gave very poor results from self-pollination. Waite concluded from his experiments that cross-pollinated apples were " larger, more highly colored, and better supplied with seed."—(Year Book, U.S. Dept. Agr. 1898, p. 177.)

The Pear. Waite's experiments on pollination of the pear show convincingly that pears require cross-pollination. He found the Anjou, Bartlett, Clapp's Favorite, Clairgeau, and others completely self-sterile, while the Flemish Beauty, Seckel, and Angouleme to be more or less self-fertile. The Kieffer and LeConte are self-sterile in the north.

Self-fertilized pears are deficient in seeds, while crosses are well supplied with sound seeds. Even with those varieties that are self-fertile the pollen of another variety is prepotent; the normal typical fruits are crosses.

The Plum. Experiments showed that " out of 153 blossoms covered of the Arkansas Lombard no fruit set; that out of 457 blossoms covered of the Wild Goose (Prunus Americana) no fruit set; and that out of 90 blossoms covered of the Japanese plum (Maru) no fruit set."

Prof. Waugh (Rep. Vt. Agr. Exp. St. 1897-8, p. 237) found the following insects pollinating the plum: honey bee, bumble bee, wasp, and some short-tongued bees.

In experiments carried out in 1907 at Denton, Md., Prof. Waugh secured the following results:

Of 490 blossoms that were covered belonging to Japanese varieties of plums none set fruit; of several covered blossoms of the Wild Goose varieties none set fruit; and of 449 covered blossoms of the Chicasaw group none set fruit. On the other hand, unprotected blossoms of the same varieties had a moderate crop of fruit, due to the very unfavorable weather conditions during the blooming time.

With regard to the question, " Are the visits of insects really necessary to pollination," Prof. Waugh continued his experiments at Denton, Md., in 1908, with the following results:

On 457 covered blossoms of chicasaw varieties no fruit set; on 216 covered blossoms of Japanese varieties no fruit set; on 457 covered Wild Goose plums no fruit set. On the other hand, the unprotected blossoms set a fair crop of fruit in spite of unfavorable weather.

Professor Waugh says, " These results indicate that insect visits are of prime importance in the pollination of plums. Observation in the field shows that the common honey bees are nearly always the most active workers, and the ones which by the character of their operations in the flower, may be held chiefly responsible for the proper distribution of pollen."—(Rep. Vt. Ag. Exp. St. 1897-8, pp. 246-247).

Mr. C. H. Hooper (Jour. Roy. Hort. Soc., March 1912) found that when insects were excluded from Gooseberries, Red and White Currants, practically no fruit was formed; from Cherries not a single fruit set; from Plums a few set fruit; from Apples, out of 63 varieties on which unopened blossoms were enclosed and left untouched the only one on which fruit set and matured was Irish Peach; and from Raspberries fruit set but the results were not so good as with flowers exposed.

Red Clover. Darwin carried out some interesting experiments regarding the fertilization of red clover. He says, " One hundred flower heads on plants protected by a net did not produce a single seed, while a hundred heads on plants growing outside, which were visited by bees, yielded sixty-eight grains of seeds."

Hermann Müller says the honey bee " usually visits the red clover only for its honey, which its proboscis is not able to reach in a legitimate manner, yet now and then I have seen hundreds of honey bees in a patch of red clover, all busy collecting pollen." He records thirty-nine kinds of insect visitors to red clover.

Dr. L. H. Pammel and Charlotte M. King of the Iowa State Agricultural College, Iowa Academy of Science (Contribution 47, Botanical Department 1912) discuss the pollination of Clover. As a result of observations and experiments carried on at Ames for several years they conclude that red clover is fertilized through the agency of bees. They found no evidence in favor of the theory that clover is fertilized before the flowers open. Moreover they maintain that, although the number of blossoms in a large field to be fertilized is very great, the bee pollinators " can accomplish in the season an important part toward the cross-pollination of the field of clover blossoms." Experiments conducted in the field showed that blossoms protected from bee visits set practically no seeds.

White Clover. Darwin experimented with white clover and showed conclusively that cross-pollination is necessary. Twenty protected heads were compared with ten unprotected, the result being that the former yielded a single aborted seed while the latter, which was visited by bees yielded 2290 seeds.

Alfalfa or Lucerne. Several investigators have shown conclusively by experimentation that insects are necessary to fertilize the blossoms of Alfalfa. Burkill and Urban, Kirchner and Fruwirth, and Roberts and Freeman have proved that seed production is prevented almost entirely when insects are excluded from the blossoms.—(Bul. 151 Kansas Agric. Exp. St., 1907.)

Dr. H. J. Webber of Cornell University, in a recent letter dated Dec. 7th on the effect of bumble bees in the production of clover, says, " I know of no recent experiments on this subject which have been published, but I do know of several experiments which have been carried out in different parts of the country which uphold Darwin's view point of the action of bumble bees. I can hardly understand how Garton Brothers could have been mistaken in their conclusions, but the fact is that of experiments carried on by scientific men I know of none which uphold the Garton's view point.. Mr. A. D. Shamel, who was one of my assistants while I was in Washington, D.C., made a number of experiments with red and white clover, by enclosing the flowers in bags, thus preventing the access of bees, and in all cases where the flowers were bagged scarcely ever was a seed set, due without question to the lack of pollination. Several of my assistants here at Cornell have also carried out limited experiments of this sort with the same results. We had expected to carry on rather extensive clover experiments and had a lot of material brought together, but gave up the idea of hybridization owing to the difficulty of getting self-fertilized seeds; clover being in general almost self-sterile under ordinary conditions."

We may therefore summarize the foregoing remarks in the words of A. A. Phillips, Bee Expert in the Bureau of Entomology, Washington, who says: "The production of millions of dollars worth of fruit in the United States depends largely on insect pollination, and no insect is so important in this work as the honey bee. It is a most conservative estimate to claim that the honey bee does more good to American Agriculture in its office as a cross-pollinator than it does as a honey gatherer."

INSECTS INJURIOUS TO FARM, GARDEN AND ORCHARD CROPS.

W. Lochhead, Macdonald College

An attempt is made here to furnish the farmer, gardener and fruit-grower a ready means of identifying the insects that may trouble their crops. Every insect is known by the character of the injury it produces, and in the case of farm and garden crops such a character is made the basis of identification. With orchard insects, however, a combination of three characters, viz.: the injury produced, the part of the tree injured, and the general appearance of the insect, is employed.

It is believed that the average farmer and fruit-grower will be able to use this method of determining the insects which injure their crops.

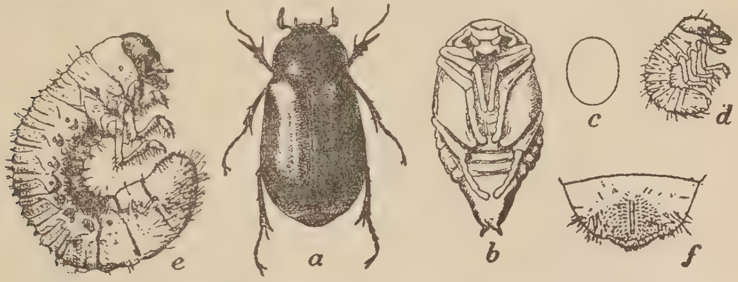
Moreover, it is the duty of every person who attempts to grow crops successfully to observe his crops carefully for the first indications of injury from insects, for prevention is better than cure. If he makes careful observations as to the nature of the injuries, and the character of the insects that are present, he is in a position to get proper advice from the expert, whom he may consult, regarding the best methods of control.

INSECTS INJURIOUS TO WHEAT, RYE, BARLEY AND OATS

The Roots.

1. Plants are stunted, turn yellow, and wither or die; roots eaten.

(a) Smooth, slender, wire-like, 6-legged worms are present in the soil. —**Wireworms.**



May Beetle: *a.* beetle; *b.* pupa; c. egg; *d. e.* larva (White Grub)—slightly enlarged. (Chittenden, Bull.) 19, n.s., Div. of Ent., U.S. Dept. of Agr.

(b) There are present in the soil large soft-bodied whitish grubs, with brown heads and hinder portion of body thicker than fore end. When disturbed grubs curl up.—**White grubs.**

(c) Large dirty brown maggots, $\frac{1}{2}$–1 inch long.—**Meadow Maggots.**

The Stems and Leaves.

1. Young plants dwarfed, and color changed to yellow or brown; stems shrivelled at the base, often bent or broken off; " Flax-seed " objects found emnedded at or near the base.—**Hessian Fly** (Cecidomyia destructor).

2. Stems above last joint dead, and the heads white—" Silver-top " or whitehead " disease. Greenish maggot in stem above last joint.—**Wheat Stem Maggot** (Meromyza Americana) and American Frit-Fly (Oscinis carbonaria).

3. Swellings or galls on the joints, and the stems bent or broken before harvest.—**Joint Worm** (Isosoma tritici).

4. Leaves sickly and whitish; the presence of small red and larger black and white bugs.—**Chinch Bug.** (Blissus leucopterus).

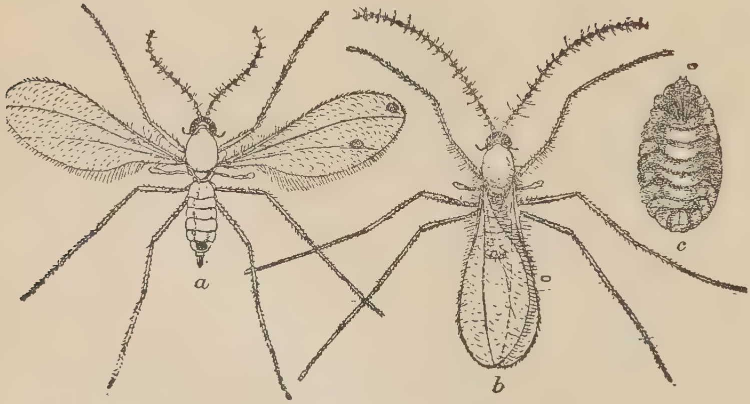
5. Stems and leaves sickly; the presence of many green plant lice.—**Wheat Plant Louse.** (Nectarophora avenae.)

6. Stems and leaves eaten by large dingy caterpillars.—**Army-worm.** (Leucania unipuncta.)

7. Leaves eaten by grasshoppers.—**Red-legged grasshoppers** (Melanoplus femur-rubrum.

The Heads.

1. Heads turn white and grains are shrivelled or imperfectly filled.—**Wheat Stem Maggot** (Meromyza Americana) and **American Frit-Fly** (Oscinis carbonaria.)



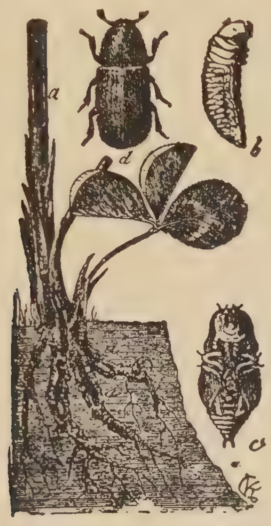
Wheat midge (Diplosis tritici); *a*, female fly; *b*, male fly; *c*, larva, ventral view—all enlarged. (Marlatt).

2. Heads shrivelled and blighted, and imperfectly filled, with the presence of orange-colored maggots.—**Wheat Midge** (Diplosis tritici).

3. Heads covered with green plant lice.—**Grain louse** (Nectarophora avenae).

INSECTS INJURING CLOVER AND ALFALFA

(Consult Bul. 134 Illinois Agric. Exper. Station, 1909.)



The Clover Root-borer—(Riley).

The Roots:—

(a) Second year plants wilt and die, and break off easily at the crown. Main root tunnelled and occupied by white footless grubs or little dark brown cylindrical beetles.—**Clover Root Borer** (Hylastinus obscurus).

(b) Plants wilted and leaves die, mealy bugs near crown of root.—**Clover Root Mealy Bugs** (Pseudococcus trifolii.)

The Stems:—

(a) A long burrow with brown discolored walls in the pith of the stem which falls to the ground prematurely.—**Clover-Stem Borer** (Languria mozardi)

(b) Stems cut off or eaten.—**Cutworms** and **Army Worms** (Leucaniia unipuncta) or **Grasshoppers.**

(c) Stems and leaves wither and die; plants covered with big green long-legged plant lice.—**Pea** or **Clover Plant-Louse** (Macrosiphum pisi).

The Leaves:—

(a) Leaves full of round holes, and edges gnawed.—**Clover-Leaf Weevil** (Phytonomus punctatus).

(b) Leaves eaten and with a ragged appearance.—**Grasshoppers.**

(c) Leaves folded along midrib, yellowish or brownish, with white or orange maggots or silken cocoons within the folds.—**Clover-Leaf Midge** (Cecidomyia trifolii).

The Heads and Seed:—

(a) Florets at blossoming time green and undeveloped; the ovaries empty or with an orange pink or whitish maggot.—**Clover-Seed Midge** (Cecidomyia leguminicola).

(b) Seeds eaten, and become brown, brittle, and hollow; affected seeds are dull brown and often misshapen and of small size; maggot minute, white and footless.—**Clover-Seed Chalcid**(Bruchophagus funebris).

(c) Unopened blossoms destroyed, a cavity eaten in the head.—**Clover-Seed Caterpillar**(Enarmonia interstinctana).

Stacked or Stored Clover Hay:—

(a) Hay containing white silky webs and particles of excrement.—**Clover Hay-Worm** (Hypsopygia costalis).

INSECTS INJURING INDIAN CORN.

Planted Seed—

(a) The plant fails to come up after planting; grain destroyed by a footless maggot which eats out the interior—**Seed-Corn Maggot** (Phorbia fuciceps)-

(b) The plant fails to come up, or the young plant suddenly wilts after it is above grouhe ; the presence of hard smooth yellowish wire-like worms—**Wirewoms** (several species).

The Roots—

(a) Young plants are killed or withered; roots eaten—**White Grubs** or **Wireworms.**

(b) Young plants unequal in growth; roots dwarfed without external injury; presence of ants—**Corn-Root Louse** (Aphis maidiradicis).

The Stalk—

(a) Plants cut off near surface of ground—**Cutworms.**

(b) Plant unthrifty and covered with greenish plant lice—**Corn-Plant Louse** (Aphis maidis).

The Leaves—

(a) Leaves thickly covered with green plant lice—**Corn-Plant Louse** (Aphis maidis).

(b) Leaves eaten—**Army Worm** (Leucania unipuncta) or **Grasshopper.**

The Ear—

(a) Developing kernels eaten, with much excrement—**Corn-Ear Worm** (Heliothis armiger).

(b) Stalks of ears covered with plant lice—**Corn-Plant Louse** (Aphis maidis).

INSECTS INJURING PEAS AND BEANS.

The Planted Seeds—

(a) Plant fails to come up, may be caused by **white grubs** or **wireworms,** or **Bean or Seed Corn Maggot.**

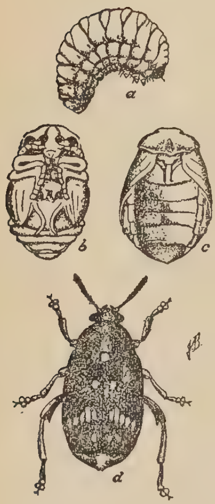
The Stalk and Leaves—

(a) Plants cut off at night—**Cutworms.**

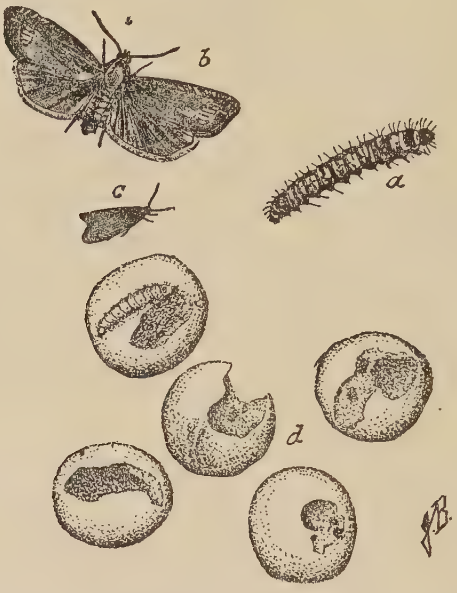
(b) Plants unhealthy often killed due to sucking lice—**Pea Louse** (Macrosiphum pisi).

The Pods—

(a) Seeds (peas) within the pod partly eaten and web-covered; pellets of excrement about injured seed—**Pea Moth** (Semasia nigricana).



Pea Weevil.—*a*, The grub: *b*, the pupa; under surface; *c*, the pupa, upper surface; *d*, the adult weevil.



Pea Moth.—*a*, A full grown "worm" or caterpillar (enlarged); *b*, adult moth with wings expanded (enlarged); *c*, adult moth with wings closed; *d*, a group of five peas injured by the caterpillar of the pea moth.

(b) Seeds within the pod (peas) perforated with holes; footless grub within the pea—**Pea Weevil** (Bruchus pisorum).

(c) Seeds (Beans) perforated with (sometimes many) holes; footless grubs within—**Bean Weevil** (Bruchus obtectus).

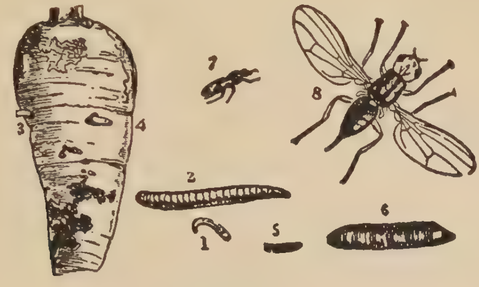
INSECTS INJURIOUS TO ROOT CROPS.

Turnips, rape, mangels and carrots.

(Consult Bul. 52 C. E. Farm, Ottawa, and Bul. 60 Ill. Exp. Sta.)

The Roots—

(a) Tips of roots of young carrots with rusty patches on surface, or rust colored tunnels in the pulp, due to slender yellowish white maggots—**Carrot Rust Fly** (Psila rosae).



The Carrot Rust;fly—1, 5, 7, natural size; 2, 6, 8, enlarged. (Curtis)

(b) Roots of turnips bored or tunnelled by minute grubs—**Turnip Flea Beetle** (Phyllotreta vittata); **Cabbage Root Maggot** (Phorbia brassicae).

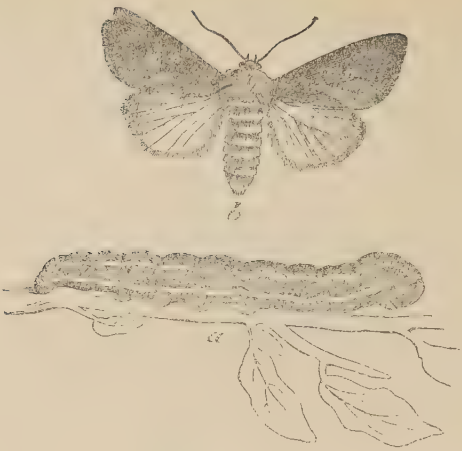
(c) Roots cut off—**Wireworms, White Grubs, Cutworms.**

The Stem and Leaves—

(a) Young plants cut off at the ground—**Cutworms.**

(b) Surface of first leaves of turnip and rape eaten into small holes by small black, striped beetles—**Turnip Flea Beetle** (Phyllotreta vittata).

(c) Leaves partly consumed by pale green caterpillars—**Cabbage Worm** (Pontia rapae).



Zebra Caterpillar (*Mamestra picta*, Harris).

(d) Leaves eaten by caterpillars with black and yellow stripes—**Zebra Caterpillar** (Mamestra picta).

(e) Leaves wilt and turn yellow, and presence of greenish lice—**Turnip Plant Louse.**

(f) Young leaves eaten into holes and irregular blotches by small active green caterpillars—**Diamond Back Moth** (Plutella cruciferarum).

(g) Under-surface of leaves covered with a very fine loose web; leaves yellowish in patches, and minute red objects present—**Red Spiders.**

(h) Leaves minutely specked by small spots; hopping insects present—**Leaf Hoppers.**

INSECTS INJURIOUS TO THE POTATO CROP.

The Tubers—

(a) Surface of tuber eaten and eyes sometimes destroyed so that growth does not take place; or holes bored in the tuber—**White Grubs, Wireworms, Millipedes.**

The Stalks and Leaves—

(a) Stalks cut off at the ground—**Cutworms.**

(b) Leaves eaten and infested with reddish soft grubs and striped beetles—**Colorado Potato Beetle** (Leptinotarsa decemlineata).

(c) Leaves riddled with small holes or surface eaten in spots—**Potato Flea Beetle** (Epitrix cucumeris).

(d) Leaves eaten and with a ragged appearance; presence of long black or striped beetles—**Blister Beetles** (Epicauta spp.).

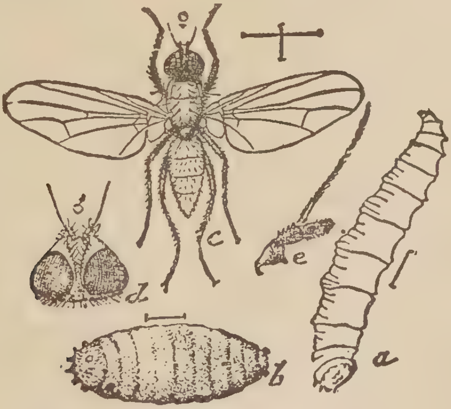
(e) Stalks wilt and die, tunnel in stalk near the ground, and presence of a white footless grub—**Potato Stalk Borer** (Trichobaris trinotata).

INSECTS INJURIOUS TO GARDEN VEGETABLES.

Under the term "Garden Vegetables" may be included Asparagus, Beets, Cabbage, Cauliflower, Celery, Cucumber, Onion, Parsnip. (Carrots, beans, peas and potatoes have already been considered.)

The Roots—

(a) Roots of cabbage and cauliflower and bulb or base of onion mined by white maggots—**Root Maggots** (Phorbia brassicae and Phorbia ceparum).



Cabbage Maggot: *a.* larva; *b.* pupa; *c.* adult. (Riley)

(b) Roots of cucumber, squash, melon and pumpkin eaten, and plants fail to come up—**White Grubs, Wireworms.**

(c) Roots of Cucumber, etc., gnawed and mined, plants wilt and die—**Striped Cucumber Beetle** (Diabrotica vittata).

The Stems and Leaves—

(a) Young plants cut off near surface of ground—**Cutworms.**

(b) Stalks and vines and leaves of cucumbers, etc., eaten, and base mined by small white grubs—**Cucumber Beetles** (Diabrotica spp.).

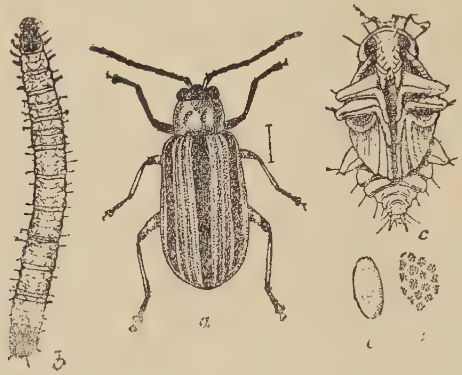


Fig. 3.—*Diabrotica vittata:* a.beetle; b. larva; c. pupa; d. egg; e. sculpture of same—a. b. c. much enlarged; d. more enlarged; e. highly magnified. (After Chittenden.)

(c) Leaves of cabbage, etc., ragged, eaten by pale green caterpillar—**Cabbage Worm** (Pontia rapae).

(d) Vines of cucumber, etc., wilted and presence of large dark stink-bugs on leaves—**Squash Bug** (Anasa tristis).

(e) Leaves and vines of cucumber, etc., sickly and dirty, under-surfaces infested with greenish black lice—**Melon Plant Louse** (Aphis cucumeris).

(f) Surface of leaves of cucumber, etc., eaten by small black beetles—**Cucumber Flea Beetle** (Epitrix cucumeris).

(g) Leaves of cabbage, etc., wilted down, and under surface covered with greenish plant lice—**Cabbage Plant Louse** (Aphis brassicae).

INSECTS INJURIOUS TO APPLES.

The Roots—

1. Causing knots or swellings on the smaller roots, bluish-white mouldy lice—**Woolly Aphis** (Schizoneura lanigera).

The Trunk, Branches and Twigs—

(a). Producing longitudinal slits in the bark; eggs under the edges of the slits—**Buffalo Tree-Hopper** (Ceresa bubalus).

b. Fixed to Bark—

1. Producing an ashy gray incrustation on the bark; scales round, and gray and black—**San Jose Scale** (Aspidiotus perniciosus).

2. Bark rough with mussel-shaped scales—**Oyster-Shell Scale** (Lepidosaphes ulmi).

3. Bark scurfy with white scales—**Scurfy Scale** (Chionaspis furfurus).

c. Making Tunnels in the Wood—

1. Large square-headed legless borer at or near the ground in tunnels, with sawdust-like excrement—**Round-Headed Borer** (Saperda candida).

THE ROUND-HEADED APPLE-TREE BORER

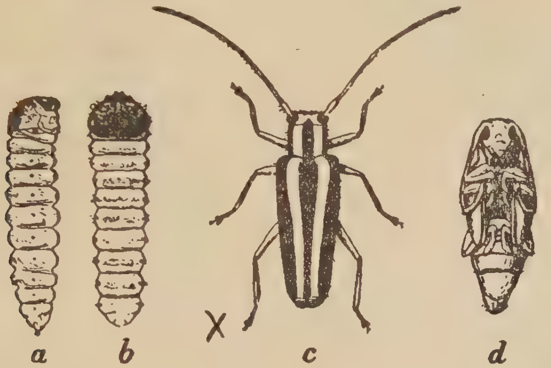


Fig. 13—*Saperda candida:* *a.* larva, from side; *b.* from above; *c.* female beetle; *d.* pupa—all enlarged one-third. (From Chittenden.)

2. Large flat-headed legless borer in upper trunk in tunnels with sawdust-like excrement—**Flat-Headed Borer** (Chrysobothris femorata).

3. Large larva in decaying wood—**Eyed Elater** (Alaus oculatus) and **Rough Osmoderma** (Osmoderma scabra).

d. Making tunnels between the bark and wood—

1. **Fruit Bark Beetle** (Scolytus rugulosus).

(e) White woolly patches on the twigs which are usually scarred—**Woolly Aphis** (Schizoneura langera).

(f) Green soft-bodied insects in clusters on young growths, and particularly at ends of twigs, producing distortions—**Apple Aphis** (Aphis mali).

(g) Snout Beetles gnawing off the bark in patches—**Imbricated Snout-Beetle** (Epicaerus imbricatus).

The Buds—

(a) Folding together the opening leaves and feeding within—**Oblique Banded Leaf-Roller** (Cacoecia rosaceana), and **Leaf Crumpler** (Phycis indiginella).

(b) Eating the centre of the bud, or tunnelling it—**Eye-Spotted Bud Moth** (Tmetocera ocellana).

(c) Measuring Worms, eating leaves of buds—**Canker Worms** (Alsophila pometaria).

(d) Caterpillars feeding with pistol-shaped cases and eating irregular holes in the bud leaves—**Pistol Case-Bearer** (Coleophora malivorella).

(e) Caterpillars feeding within cigar-shaped cases and eating small round holes in the bud leaves—**Cigar Case-Bearer** (Coleophora fletcherella).

The Leaves—

(a) Gregarious caterpillars.

1. Caterpillars protected by webs—

(a) Webs in forks of branches in spring—**Tent Caterpillar** (Clisiocampa Americana).

(b) Webs covering the leaves in summer and early autumn—**Fall Web-Worm** (Hyphantria cunea).

(c) Leaves partly eaten and drawn together by a web—**Palmer Worm** (Ypsolophus pometellus).

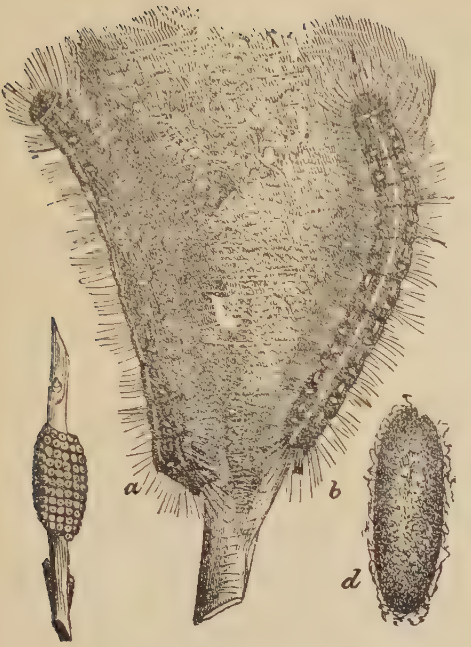
2. Caterpillars not protected by a web—

(a) Clustered on limbs—**Yellow-necked Caterpillar** (Datana ministra).

(b) **Red-Humped Apple-Tree Caterpillar** (Oedemasia concinna).

3. Green soft-bodied insects with sucking mouths—Plant Lice.

(b) Solitary Caterpillars.



Apple Tree Tent-caterpillars on their web; *c*, egg-bracelet; *d*, cocoon.

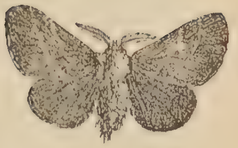
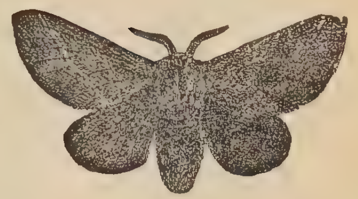
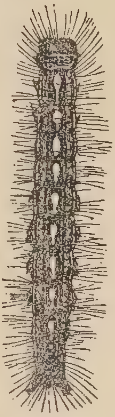


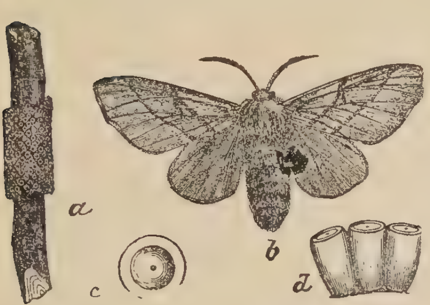
Fig. 5 Tent-caterpillar.
Male Moth.



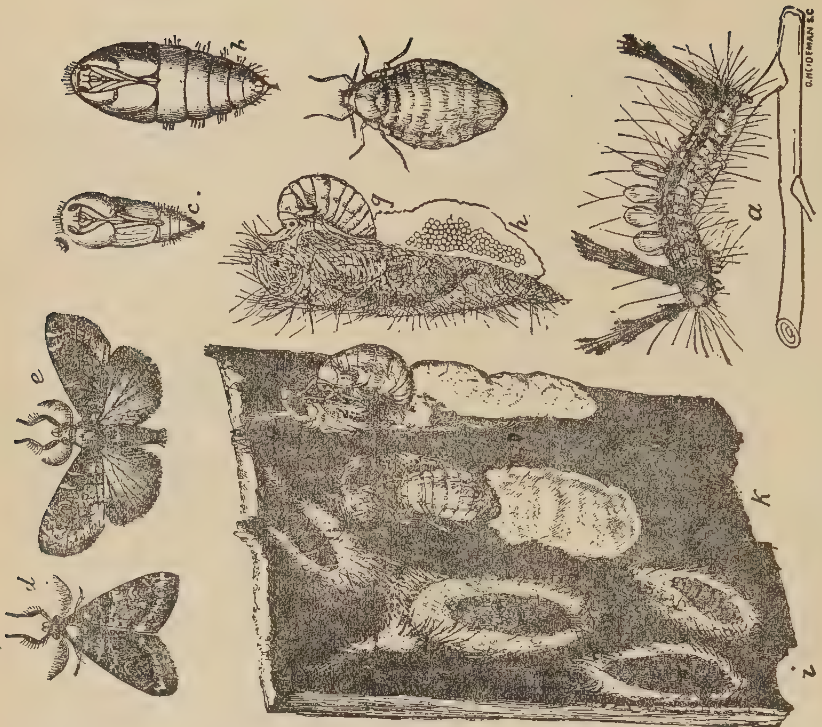
6. Female Moth.



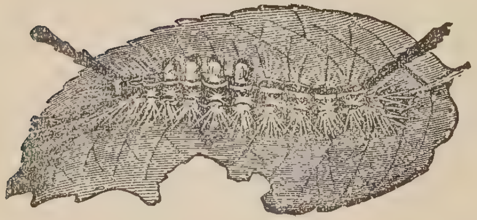
Forest Tent-caterpillar.



Forest Tent-caterpillar: Moth and eggs.



Tussock Moth in all stages: *a*, caterpillar; *b*, female chrysalis; *c*, male chrysalis; *d* and *e*, male moths; *f*, wingless female moth; *g* female moth laying her eggs (*h*) on the cocoon from which she has emerged; *k*, female moths, their cocoons and egg masses, on the bark of a tree.



Tussock Moth; full-grown caterpillar.

White marked Tussock Mot ..

1. Protected Caterpillars—

(a) Mining within the leaf, pupa inside of folded leaf—**Apple-Leaf Miner** (Tischeria malifoliella).

(b) Mining within the leaf; mature larva and pupa within small oval seed-like bodies—**Resplendent Shield-Bearer** (Aspidisca splendoriferella).

(c) Feeding within pistol-shaped cases which stand out from the leaf—**Pistol Case-Bearer** (Coleophora malivorella).

(d) Feeding within cigar-shaped cases, which stand out from the leaf—**Cigar Case-Bearer** (Coleophora fletcherella).

(e) Feeding within folded leaves—**Leaf Roller** (Teras malivorana and Cacoecia rosaceana).

(f) Feeding within tubes of silk, open at both ends, on epidermis and inner tissues leaving the veinlets—**Bud Moth** (Tmetocera ocellana).

(g) Feeding on tissues of leaves beneath a silk web—**Apple-Leaf Skeletonizer** (Pempelia Hammondi).

2. Unprotected Caterpillars.

(a) Measuring worms in spring, feeding in the day-time—**Canker Worms** (A. pometaria and P. vernata).

(b) Sleek 16-legged caterpillars, feeding at night—**Cutworms.**

(c) Large green caterpillar, covered with spiny tubercles—**Cecropia Moth.**

(d) Large apple-green caterpillar with white oblique stripes on sides—**Polyphemus Moth** (Telea polyphemus).

(e) Hairy caterpillar with long black tufts over head and tail—**Tussock Moth** Hemerocampa (leucostigma).

(f) Large green caterpillar with a reddish brown horn at tail, and seven oblique stripes on each side—**Apple Sphinx** (Sphinx gordius).

(g) Small caterpillar with brown head and yellowish-green body, feeding on leaves—**Apple-Tree Bucculatrix** (Bucculatrix pomifoliella).

3. Beetles—

(a) Large brown beetle feeding at night on leaves—**May Beetle** (Lachnosterna fusca).

(b) Small brown beetles, feeding at night—**Leaf Beetles.**

The Fruit—

(a). Boring tunnels through the fruit—

1. Tunnels mostly about the core—brown excrement often visible at opening at blossom end of apple—**Codling Moth** (Carpocapsa pomonella).

2. Tunnels irregular and numerous—**Apple Maggot** (Trypeta pomonella).

(b). Puncturing the Fruit—

1. Puncturing the fruit and distorting it, a 4-humped beetle—**Apple Curculio** (Anthonomus quadrigibbus), **Plum** Curculio (Conotrachelus nenuphar).

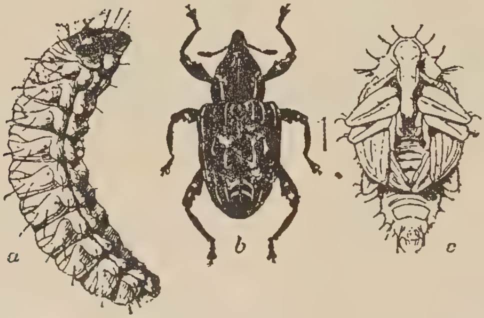


Fig. 12...The plum curculio (*Conotrachelus nenuphar*) : *a.* larva ; *b.* adult ; *c.* pupa. Much enlarged (hair line to right of *b* indicates natural length of adult.

2. Purplish spots about the circular scales—**San Jose Scale** (Aspidiotus perniciosus).

(c). Eating holes in the fruit—

1. Large light yellow or apple green caterpillars with a narrow cream-colored stripe along middle of the back—**Green Fruit Worms** (Xylina sp.).

2. Beetle, yellowish, hairy, one-half inch long—**Bumble Flower-Beetle** (Euphoria inda).

INSECTS INJURIOUS TO THE PLUM.

The Roots—

(a) Burrowing about the crown of the roots, occasionally in young trees—**Peach-Tree Borer** (Sannina exitiosa).

The Trunk, Branches and Twigs—

(a) Making tunnels in the wood, sawdust-like excrement at the mouth of tunnels—**Flat-Headed Borer** (Chrysobothris femorata).

(b) Making tunnels in the bark—**Fruit Bark-Beetle** (Scolytus rugulosus).

(c) Bases of buds perforated, the bark becomes discolored, and the leaves and fruit wither—**Pear-Blight Beetle** (Xyleborus pyri).

(d) Fixed to Bark—

(1) Flat or saddle-shaped, or hemispherical dark brown scales. Large scales after mid-summer are brittle and contain only a whitish dust or empty egg-shells. Wintering forms are small and flattish—**Plum Lecanium** (Lecanium cerasifex).

(2) Ashy gray appearance of bark of badly infested trees; small gray or black circular scales—**San Jose Scale** (Aspidiotus perniciosus).

(3) Mussel-shaped scales, with whitish eggs underneath in winter—**Oyster-Shell Scale** (Lepidosaphes ulmi).

(4) Bark scurfy with scales, purplish eggs underneath in winter—**Scurfy Scale** (Chionaspis furfurus).

(e) Producing longitudinal slits and eventually oval-shaped scars—**Buffalo Tree-Hopper** (Ceresa bubalus).

The Leaves—

(a) Feeding in Colonies.

(1) Protected by webs in the forks of branches—**American Tent-Caterpillar** (Clisiocampa Americana).

(2) Protected by webs covering the leaves—**Fall Web-Worm** (Hyphantria textor).

(3) Not protected by webs, greenish lice with suckling mouths—**Plum-Leaf Aphis** (Aphis prunifolii).

(b) Solitary.

(1) Measuring worms, feeding in the day time and in Spring—**Canker Worms**—(Alsophila pometaria).

(2) Fat, greasy caterpillars, feeding at night in spring—**Cutworms.**

(3) Hairy caterpillars with long black plumes over head and tail—**Tussock Moth** (Hemerocampa leucostigma).

()4 Large buzzing beetle—**June Bug** (Lachnosterna fusca).

(5) Large apple-green caterpillar, with a tail horn, and with seven broad oblique white stripes along each side—**Plum-Tree Sphinx** (Sphinx drupiferarum).

Other larvae are occasionally found feeding on the leaves of plum: **The Viceroy** (Limenitis disippus), **Polyphemus** and **Cecropia.**

The Fruit—

(a) Puncturing and making a crescent-shaped slit in the skin of the young fruit, which soon drops—**Plum Curculio**—(Conotrachelus nenuphar).

(b) Making a round hole in the young fruit—**Plum Gouger** (Coccotorus scutellaris).

(c) Eating holes in the ripe fruit—**Bumble Flower-Beetle** (Euphoria inda).

(d) Eating holes in the half-ripe fruit—**Rose Chafer** (Macrodactylus subspincsus).

INSECTS INJURIOUS TO THE CHERRY.

The Root—

((a Thick whitish grub, with brown head and legs, feeding in decaying roots. Beetles large with powerful mandibles—**Stag Beetle** (Lucanus dama).

(b) Large white fleshy grub, with reddish head, feeding in old roots—**Rough Osmoderma** (Osmoderma scabra).

The Trunk, Branches and Twigs—

(a) A snout beetle gnawing the twigs and fruit—**Imbricated Snout Beetle** (Epicaerus imbricatus).

(b) A small beetle boring in the branches just above a bud, and burrowing downwards—**Apple Twig Borer** (Amphicerus bicaudatus).

(c) A flattened grub tunneling in the bark and sap-wood; beetle bronzy metallic—**Divaricated Buprestis** (Dicerca divaricata).

(d) Large sucking insect with transparent wings inflicting wounds on the smaller limbs, and depositing eggs therein in August and September—**Dog-Day Cicada** (Cicada tibicen).

(e) Small circular scales, black in winter, with a circular depression about a central nipple—**San Jose Scale** (Aspidiotus perniciosus).

The Leaves—

(a) A small beetle feeding on the leaves of red cherry—**Cherry-Leaf Beetle** (Galerucella clavicollis).

(b) A slug, shiny, dark green, one-half inch long, feeding on soft tissues, leaving the veins—**Pear or Cherry Slug** (Eriocampa cerasi).

(c) Shining black plant lice infesting the terminal twigs chiefly, which become distorted and discolored—**Cherry Aphis** (Myzus cerasi).

(d) Large, bluish green caterpillar, two inches long with blue warts on each segment, and coral red ones on the third and fourth segments—**Promethea Moth** (Callosamia promethea).

(e) Large pale green spiny caterpillar, striped on each side with white and lilac—**Io Moth** (Hyperchiria Io).

(f) Caterpillars in colonies protected by webs in forks of branches in spring—**American Tent Caterpillar** (Clisiocampa Americana) and **Forest Tent Caterpillar** (not in webs).

(g) Caterpillars in colonies protected by webs covering the leaves in summer and early autumn—**Fall Web Worm** (Hyphantria cunea), and other insects, most of which also attack the leaves of apple.

The Fruit—

(a) Making a crescent cut on the cherry; grub, white and footless, with a brownish horny head, feeding within—**Plum Curculio** (Contrachelus nenuphar).

(b) Yellowish white maggots feeding on the pulpy juices near the pit, inducing a rotting—**Cherry Frit Fly** (Rhagoletis cingulata).

INSECTS INJURIOUS TO THE PEACH.

Attacking The Root and Lower Trunk—

(a) Tunneling in the bark and sapwood of the root, causing an exudation of gum, which is seen at base of tree mingled with the castings—**Peach Tree Borer** (Sannina exitiosa).

Attacking the Trunk and Branches—

(a) In early spring a minute caterpillar bores into the shoots of new leaves, killing the growing terminals—**Peach Twig Borer** (Anarsia lineatella).

(b) Black hemispherical scales attached to the bark—**Peach Leaf Lecanium** (Lecanium nigrofasciatum).

(c) A beetle eating the buds and gnawing into the base of the twigs, causing them to break and fall—**New York Weevil** (Ithycerus noveboracensis).

(d) Round scales, gray or black, twigs presenting a scurfy appearance—**San Jose Scale** (Aspidiotus perniciosus).

(e) Oval scars and longitudinal slits on back—**Buffalo Tree-Hopper** (Ceresa bubalus).

Attacking the Leaves—

(a) Plant lice, living in colonies under the leaves, causing them to thicken and curl—**Peach Tree Aphis** (Myzus persicae).

(b) Minute round scales, usually along the veins—**San Jose Scale** (Aspidiotus perniciosus).

(c) Caterpillars protected:

(1) In a tortuous tube—**Leaf Crumpler** (Phycis indiginella).

(2) In folded leaves—**Oblique Banded Leaf Roller** (Cacoecia rosaceana).

Attacking the Fruit—

(a) Long legged, yellowish beetles eating holes in half-grown peaches—**Rose Chafer** (Macrodactylus subspinosus).

(b) Large yellow, hairy beetles, eating holes in ripe peaches—**Bumble Flower-Beetle** (Euphoria inda).

(c) Small snout beetles making a puncture and crescent in the young fruit—**Plum Curculio** (Conotrachelus nenuphar).

INSECTS INJURIOUS TO THE RASPBERRY AND BLACKBERRY, Etc.

The Roots and Base of Canes—

(a) Large grub over two inches long, boring large tunnels in the woody portions of main root. The canes suddenly die—**Giant Root-Borer** (Prionus laticollis).

(b) Canes at base of main root girdled by a yellowish white caterpillar in late summer and autumn—**Bramble Crown Borer** (Bembecia marginata).

The Canes—

(a) Longitudinal row of punctures on canes—**Snowy Tree-Cricket** (Ecanthus niveus).

(b) Tips of raspberry canes wilting in early summer, due to a girdling of the canes inside the bark—**Raspberry Cane Maggot** (Phorbia rubivora).

(c) Tips of shoots of raspberry wilting, two rows of punctures one inch apart at base of wilted portion, with a small hole between. Canes are burrowed to the base before autumn—**Raspberry Cane Borer** (Oberea bimaculata).

(d) Swellings on canes of raspberry and blackberry—**Red-Necked Cane-Borer** (Agrilus ruficollis).

The Buds—

(a) A small snout beetle, puncturing the flower stem close to the buds, and also the buds—**Strawberry Weevil** (Anthonomus signatus).

(b) A small yellowish beetle eating the flower buds, which fail to open or wither—**Pale Brown Byturus** (Byturus unicolor).

(c) A small brownish caterpillar eating the opening buds—**Bud Moth** (Tmetocera ocellana).

The Leaves—

(a) Insects sucking the sap of young growing parts, and arresting their development—**Tarnished Plant Bug** (Lygus pratensis).

(b) Suckers and leaves curl up with enclosed lice—**Bramble Flea-Louse** (Trioza tripunctata).

(c) Small larva eating the leaves in spring—**Raspberry Saw-Fly** (Monophadnus rubi).

The Fruit—

(a) A looper feeding on fruit of raspberry and blackberry—**Raspberry Geometer** (Synchlora glaucoria).

INSECTS INJURIOUS TO THE GOOSEBERRY AND CURRANT.

The Canes—

(a) Tips of canes girdled and wilted; pith tunneled—**Currant Stem Girdler** (Janus integer).

(b) Center of cane tunneled by a white caterpillar—**Imported Currant Borer** (Sesia tipuliformis), and **Snowy Tree-Cricket** (Ecanthus niveus).

(c) Small flat circular scales, black or gray, with a depressed ring about a central nipple in black forms—**San Jose Scale** (Aspidiotus perniciosus).

(d) Oval, hemispherical scales—**Currant Lecanium** (Lecanium ribis).

The Leaves—

(a) Larvae, 20-legged, dull white when young, then greenish with black spots, finally greenish yellow, eating holes in the leaves in early spring—**Imported Currant Worm** (Nematus ribesii).

(b) Leaves curled, blistered, and with a reddish appearance on upper surface, caused by yellowish plant lice—**Currant Plant Louse** (Myzus ribis).

(c) Leaves turning brown and dying—**Four-Lined Leaf-Bug** (Poecilocapsus lineatus).

(d) Measuring worm feeding on leaves of gooseberry and black currant—**Currant Span-Worm** (Diastictis ribearia).

(e) White spots on leaves, produced by a pale green sucking insect occurring on the under surface—**Currant Leaf Hopper** (Empoa albopicta).

The Fruit—

(a) Greyish caterpillar boring into young fruit and eating out its contents—**Gooseberry Fruit Worm** (Zophodia grossulariae).

(b) Purplish spots surrounding small circular scales—**San Jose Scale** (Aspidiotus perniciosus).

(c) Yellow oval maggots eating the gooseberry—**Gooseberry Midge** (Cecidomyia grossulariae).

(d) Small white grub eating the currant and gooseberry, causing the fruit to turn red and fall—**Currant Fly** (Epochra Canadensis).

INSECTS INJURIOUS TO THE GRAPE.

The Roots—

(a) Producing little irregular spherical galls on rootlets and larger roots, causing death—**Grape Vine Phylloxera** (Phylloxera vastatrix).

(b) Large borer, cutting a tube through the root near the surface—**Broad-Necked Prionus** (Prionus laticollis).

(c) Grub eating the bark of both the large and small roots—**Grape Vine Fidia** (Fidia viticida).

The Branches—

(a) Young shoots suddenly break off or droop in spring; a small hole just above the base of the shoot leads into a burrow—**Aphis Twig Borer** (Amphicerus bicaudatus).

(b) Canes show roughened, longitudinal rows of perforations in the bark—**Snowy Tree Cricket** (Œcanthus niveus).

(c) Canes exhibiting white cottony masses attached to a reddish-brown scale—**Cottony Scale** (Pulvinaria innumerabilis).

(d) Canes exhibiting white frothy masses which resemble spittle—**Spittle Insect** (Aphrophora, sp.).

The Leaves—

(a) Leaves riddled with irregular holes about mid-summer by a little beetle—**Grape Vine Fidia** (Fidia viticida).

(b) Boring into buds in spring, also eating small holes in expanding leaves; small, shining, blue beetle—**Grape Vine Flea Beetle** (Haltica chalybea).

(c) Long-legged, brownish beetles eating the blossom, leaves and fruit—**Rose Chafer** (Macrodactylus subspinosus).

(d) Greenish caterpillar, feeding within a folded leaf and skeletonizing it, about mid-summer—**Grape Leaf Folder** (Desmia maculatus).

(e) Leaves blotched and scorched, finally curling up and falling, by little jumping insects—**Grape Thrips or Leaf Hopper** (Typhlocyba comis).

(f) Large greenish caterpillar, with a pale yellow strip down each side, and a horn near tail—**Grape Vine Sphinx** (Darapsa myron).

(g) Several other sphingid larvae feed on the leaves of the Grape.

(h) Black beetle eating the tissues on the upper surface of the leaves, and discoloring them—**Red Headed Systena** (Systena frontalis).

(i) Producing reddish, elongated, conical galls on the leaves—**Trumpet Grape Gall** (Vitis viticola).

(j)Large reddish yellow beetle with six black spots on wing cover eating holes in leaves—**Spotted Pelidnota** (Pelidnota punctata).

The Fruit—

(a) Ripening fruit discolored and burrowed by a whitish caterpillar—**Grape Berry Moth** (Eudemis botrana).

(b) Eating holes in ripe fruit, beetle large, yellowish, hairy—**Bumble Flower-Beetle** (Euphoria inda).

(c) Eating holes in young fruit, a long legged beetle—**Rose Chafer** (Macrodactylus subspinosus).

INSECTS INJURIOUS TO THE STRAWBERRY.

The Roots—

(a) A pinkish caterpillar boring irregular channels through the crown and larger roots, causing them to wither and die.—**Strawberry Root-Borer** (Anarsia lineatella).

(b) A white grub boring downwards from the crown—**Strawberry Crown-Borer** (Tyloderma fragariae).

(c) A large white grub eating the roots—**May Beetle** (Lachnosterna fusca).

The Leaves—

(a) Brownish caterpillars in June and August rolling the leaves into cases and fastening them with silk—**Strawberry Leaf-Roller** (Phoxopteris fragariae).

(b) Young plants gnawed off at the surface—**Cutworms.**

(c) Small pale spotted active beetles riddle the leaves with holes in June—**Spotted Paria** (Paria 6-notata).

(d) A small active jumping striped beetle, eating holes in the leaves—**Striped Flea Beetle** (Phyllotreta vittata).

(e) Twenty-legged grubs eating holes in the leaves—**Strawberry Saw-Fly** (Emphytus maculatus).

The Fruit—

(a) A caterpillar feeding on the berry—**Stalk-Borer** (Gortyna nitela).

(b) A minute black bug, producing a buggy odor when eaten with berry—**Flea-Like Negro Bug** (Corimelaena pulicaria).

A STUDY OF THE PAINT BRUSH OR ORANGE HAWKWEED

(Reprinted from the Journal of Agriculture, Sept.-Oct. 1911)

W. Lochhead, Macdonald College

An inquiry among the farmers of the Eastern Townships.—What the best farmers are doing to control this weed.—How they view the situation.

A representative of the Journal of Agriculture had the privilege recently of spending portions of three weeks in the counties of the Eastern Townships where the Paint Brush has become a serious pest. The object of the trip was to see for ourselves the extent of the invasion of the weed and to find out what the best farmers think of the present situation and what they are doing to control it.

At the time of our trip but few plants of the Paint Brush were in bloom, consequently the extent of the infestation was not so evident as it was in June before the meadows and the roadsides were cut.

Paint Brush came to us from Europe mostly by way of Vermont, where it has been a serious pest for some ten years or more. It is capable of spreading both by means of its plumed seeds and by its runners. An infested field will soon infest adjacent fields, for the wind will carry the seed quite readily. Moreover, when a seed produces a plant new plants will arise all about it from the runners that are sent out from its base.

Another peculiar habit of Paint Brush is the manner of bearing its leaves. These are borne in the nature of a rosette, flat on the surface of the ground. As a consequence it is difficult for other plants to live where Paint Brush gets a foothold. We have seen many pastures where the weed covers every inch of the ground, having crowded out every other plant.

The flowers of Paint Brush are quite beautiful and striking, being of a bright orange-red. They are arranged in heads like those of a dandelion, only each stalk is from one to two feet high and bears a number of heads. There is no mistaking the weed in flower.

In Richmond County

A beautiful drive it is from Richmond to Ulverton along the St. Francis River, but it does not reveal the Paint Brush that grows in the fields back from the river. Inquiry along the route told us that the weed was a serious one and that many farmers did not know what to do with it. Most of them had made no determined effort to control it, having heard that it was almost impossible to cope with it. At Ulverton, however, farmers like Mr. Reed have little fear of it except in pastures and for the extra trouble it gives in controlling it in the cultivated fields. Lack of labor-help is the great cry of the farmers in this section. It is simply impossible to get capable help nowadays, they say,—the result being that weeds are not attended to at the right time. " Couch grass is our worst weed," said Mr. Reed, " and we find it very hard to control on our light soil. Where it was possible to give good autumn cultivation and continuous summer cultivation in the corn and roots the following year the couch or quack was fairly well checked. I am watching carefully the first appearances of Paint Brush and I am careful to pull up every plant I can find. As the seed is blown by the wind, it is just a question of time when it will be abundant, especially in neglected farms. These farms will then be menaces to others unless the weed by-laws are put into operation."

With regard to the labor problem Mr. Reed said : " The scarcity of suitable farm help is one of the great drawbacks to good farming at the present time. We simply can't get suitable men. Besides, I think, the Militia Department should change the time of holding the annual camp. The men leave to attend drill just at a time when we can fight weeds to best advantage."

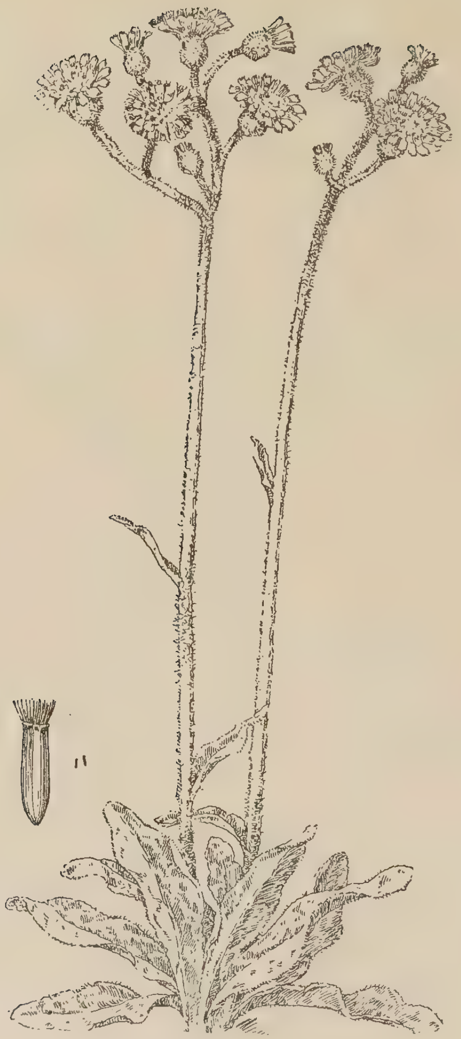
In Brome County

(For illustration see next page).

Paint Brush may be found almost everywhere in Brome County. When many farmers are asked what they are doing to control it, they confess they are doing nothing. " We have not the time to deal with it, so we just leave it alone," they reply. A drive into West Bolton settlement revealed the roadsides and meadows matted with the weed.

Mr. Hillhouse, on being asked about Paint Brush, said : " There are other weeds that I am more afraid of than Paint Brush, for example, Sow Thistle, Couch and Mustard. Cultivation will readily kill Paint Brush, and I am told that sheep will feed on it in meadows and waste lands. The trouble is, most farmers are doing nothing in the way of controlling Paint Brush."

Mr. James Pettis, one of the best farmers in West Brome, being asked his opinion regarding the weed, said : " All I can tell you may be told in a nutshell. Paint Brush will not thrive under good cultivation and good manuring. I have no trouble with it, and where farmers adopt a rotation covering four or five years, no difficulty need be anticipated. In pastures and waste lands Paint Brush gets control because the land becomes poor. If such land be run over with a spring-tooth harrow when the ground is soft, Paint Brush will be to a large extent uprooted. Then a mixture of grasses and clovers at the rate of fifteen pounds per



Devil's Paint-brush. Orange Hawkweed.—*Hieracium aurantiacum* L. A slender, thin, hairy, perennial, 20-60 cm. high, usually spreading by runners, juice milky: leaves mostly at the ground, spatulate: flowers orange-red showy. Introduced from Europe and escaped from cultivation. A terrific weed when once established. (Mich. Agric. Coll. Bull.287).

acre should be sown, and a good application of fertilizer made. These will get a good start and oust the Paint Brush. Hardhack also may be kept under by cutting in July. It would pay any man to spend a while cutting hardhack."

Mr. William Strong, also of West Brome, and the owner of a good farm, said that Paint Brush was too plentiful on his farm. He had experience with sheep as destroyers of Paint Brush. In an infested pasture, where he has a large flock of sheep, Paint Brush was kept under control, while over the fence, in a neighbor's pasture where no sheep were kept, the weed was abundantly evident. Mr. Strong was firmly of the opinion that the custom of keeping meadows in hay for a long period contributed to the spread of Paint Brush.

Mr. E. Miltimore, of West Brome town line, is one of the most progressive farmers of the district. On being interviewed, he wished he might hear of some treatment for Paint Brush that would be successful, for he confessed that he had not been able to cope with it. " I doubt very much if cultivation alone, such as is ordinarily given, will control Paint Brush," he said, " but I do think that careful cultivation during late summer and autumn and heavy fertilization will kill it out. Paint Brush makes headway whenever the land becomes worn out. Perhaps sheep will kill it, but I have had no experience along that line."

Judging from the splendid appearance of this farm, the neat well-kept farmyard, the large and commodious stables, his fine house, and his excellent herd of dairy cattle, the writer is of the opinion that Paint Brush will never make much headway on Mr. Miltimore's farm.

Clover grows well, and where clover grows there is hope for the owner. " I feed most of the hundred tons of hay I raise," said Mr. Miltimore, " but sometimes people hear that I have some to spare, and they come and get some. I haven't a silo, but I believe a silo is a good thing. I grow corn mostly for fall feeding."

On Mr. Miltimore's farm is a monolithic monument, erected by the Brome Historical Society to indicate the position of the first house built in Brome County, in 1795 by Collins.

In Sherbrooke County

Mr. Robert Mitchell, who lives near the village of Huntingville beyond Lennoxville, on being interviewed regarding Paint Brush, stated that he had the weed on his farm, and was quite anxious about its presence.

He believes, however, that it could be kept in subjection in pastures and open meadow lands by sheep, of which he keeps a flock. Mr. Mitchell showed us the field where Paint Brush existed in considerable quantity a short time ago, but since sheep have been turned in, it has practically disappeared. " I scatter salt on the areas covered by the weed," said Mr. Mitchell, " and the sheep eat the spots clear."

From a man of Mr. Mitchell's standing as a farmer, this experiment of his is worthy of much consideration, and if subsequent trials bear this one out, a practicable remedy for the Paint Brush situation in meadows is available.

Couch Grass and daisy are also bad weeds in this locality.

A trip was made along the Magog River, along both sides, to the southwest of the city of Sherbrooke, as far as Forest Rock. On the east side there is much Paint Brush, but apparently little effort is being made to subdue it. Nearly every hay field is more or less infested, and we saw an oat field with the weed very much in evidence.

Three factors stand out prominently as having an important bearing on the Paint Brush situation :—

(1) The fact that this weed spreads by means of winged seeds that are carried by the wind to adjacent fields.

(2) The fact that the great majority of the farmers do not give their land sufficient cultivation. When sod is broken up, it is plowed but once in late summer or autumn. Then it is too frequently sowed to oats the next spring without any further attempt at cleaning the land.

(3) The fact that land is kept in hay for a long period of years, with the result that the weed has an opportunity of spreading by its underground runners, and getting full possession of the fields.

In Missisquoi County

The good farmers along the Cowansville-Dunham road are not afraid of Paint Brush in land that can be cultivated. Mr. Charles Ruiter, owner of the Pinehurst Jersey Stock Farm, said, on being interviewed : " We have no trouble with Paint Brush. It is not nearly so hard a weed to eradicate as Quack grass or Sow thistle. To eradicate Paint Brush it is necessary to cultivate the land thoroughly—one plowing is not sufficient—and to manure it well. If corn or hoed crops follow there will be no fear of trouble from this weed. The lack of labor, it should be emphasized, is a great drawback to clean farming. For example, this year it was utterly impossible for me to cultivate my root crops on account of lack of help, so I shall lose my root crop on that account."

Mr. George Beach, another of the prosperous and influential farmers near Dunham village, considers that Paint Brush can be controlled by good cultivation and suitable rotation, but he is deeply concerned about the spread of the weed in his rough pastures. " When you give advice regarding the control of Paint Brush in the Journal of Agriculture, consider well," he said, " the particular and peculiar conditions that exist on most of our farms. Remember the fact that labor is scarce, that many of our pastures are too rough to cultivate, and that we do not live under the ideal conditions that exist in the minds of some writers in agricultural papers. I do not know whether sheep will keep this weed under control in pastures or not."

Joseph Lee and Son thought Paint Brush was worse this year on their farm than it was last year, but it has not yet given much trouble in their pastures. They did not believe that a single plowing of sod in the fall, followed with oats seeded to clovers and grasses, would kill it.

Mr. M. Curley, of Dunham village, said he did not know how to deal with Paint Brush in rough pastures. " Twenty-five and thirty years ago every farmer in this district kept a flock of sheep, and the pastures," he said, " were much cleaner of weeds than they are now. Yes, I believe farmers should keep more sheep, but sheep-worrying dogs have put sheep out of business. So far as Paint Brush is concerned it need not be dreaded if only good cultivation is given. One reason for the spread of this weed is the fact that many of the farms are rented and proper attention is not given to the control of weeds."

Paint Brush is very bad in the hilly district about the Pinnacle mountain near the border of Vermont. No person appears to be doing much to control it, for no practicable remedy seems to be available. Very few farmers keep sheep, but it would appear as if they would be obliged to turn to this industry if they ever hope to control the situation.

The farms in the valley leading from Freligsburg to Stanbridge East are not infested to any great extent, but there are some other bad weeds that have gained a foothold and will be hard to dislodge. Wild Carrot or Bird's Nest is very plentiful along the roadsides, and in some cases the fields are invaded. Knapweed occurs plentifully along the roadside in one locality. One of the worst cases of Sow thistle infestations was seen in an oat field between Stanbridge East and Bedford. These three weeds require careful attention and handling; if they are carelessly treated, they are liable to spread and become most serious pests.

In the section of country about St. Armand, Paint Brush is not as bad as it is farther east, but every farmer knows it and has had some dealings with it. Mr. W. A. Smith, of St. Armand, said that the railways were not doing their duty in keeping their property clear of weeds. Moreover, he thought that no great progress would be made in keeping down weeds and in preventing their spread until the Government appointed a Weed Inspector. Frequently it is necessary to force a careless neighbor to do his duty, but no farmer wants to make enemies of his neighbors. A government official could do this very well.

In Huntingdon County

While very little time was spent in the vicinity of Huntingdon some inquiries were made as to the prevalence of the Paint Brush in the townships surrounding the town. W. H. Walker, Esq., M.L.A., who knows the district about as well as any person and who is one of the most progressive farmers of this prosperous county, said that Paint Brush was present to some extent but up to the present could not be considered a troublesome pest. To be sure it has a foothold in pastures that have been allowed to run out, but in most farms to the south and west of Huntingdon the land is well cultivated and a systematic rotation of crops is practised. As a result Paint Brush does not make headway.

Mr. Gordon Wood, the newly appointed District Representative, although not well acquainted with the district, was of the opinion that Paint Brush will never become much of a pest where good cultivation is followed.

In the eastern portion of Huntingdon County, however, the Paint Brush is more of a pest than in the western part. There is more broken land that is in permanent pasture which cannot be cultivated. In such land Paint Brush is a real and threatening pest, and the farmers do not know how to prevent its spread. Messrs. Wm. Cameron and Robert Neely, of Herdman, expressed themselves quite freely regarding the situation. They believed that ordinary cultivation will kill Paint Brush, but they did not think that the too common practice of giving but one plowing to sod, sowing it to oats and seeding down to clover and timothy would control or kill the weed. They thought that sheep would keep down the weed in pastures, but unfortunately but few farmers keep sheep in their neighborhood. Mr. Neely said that twenty years ago most farmers kept sheep and the pastures were then much freer from weeds of all kinds than they are now. Sow Thistle and quack grass were, he considered, much more to be feared in cultivated land than Paint Brush.

We called upon several farmers between Rockburn and Franklin Centre, who were good enough to discuss the Paint Brush situation with the Journal representative. Mr. W. J. Moe said that the weed was abundant on loam, but not on gravelly soil. " I have no trouble in dealing with Paint Brush," he continued, " in land that I can cultivate, but I do not know how I am going to fight it in the upper pastures. I do not know if sheep will keep the weed clipped down or not. I do not mean to say that I do not mind the weed in my other fields, for I do very much.

I have to spend more time than I can afford with the help I can get in fighting the weed. The Paint Brush seed is carried by the wind from infested pastures to cultivated fields, so that one has to be constantly on the watch for its appearance. It does undoubtedly increase the burden we farmers have to bear. With regard to the cultivation necessary to kill the Paint Brush I believe it will require at least two or three cultivations in late summer and fall. If a good crop is brought on the following year so much the better. My experience points to the fact that it is easier than quack grass to kill, but still it must get more than a single plowing if we desire to control it."

Mr. George Blair, one of the best farmers of the district, said : " I have very little Paint Brush on my farm. I attribute this freedom from the weed to the fact that I am very careful to exterminate it as soon as I find it in any of my fields. I believe that a good farmer will have no difficulty in keeping his cultivated fields free from this weed. I am much more afraid of Sow thistle and quack grass. No, I see no way of controlling Paint Brush in my pastures. I do not know what is going to become of them in time."

Messrs. Clark Goldie, Fred. Fulton and Ben. Johnston, other excellent farmers of the same district, had practically the same opinions regarding the prevalence and control of Paint Brush as Messrs. Moe and Blair.

There is much Paint Brush on the high broken land between Franklin and Covey Hill. This land will, moreover, form a source of infestation for the surrounding country. No remedy seems to be at hand but the development of the sheep industry on this extensive tract of rough land.

Mr. George B. Edwards, of Covey Hill, an extensive fruit grower and for many years a Director of the Pomological Society of Quebec, received the Journal representative with his accustomed warm-heartedness, and discussed the Paint Brush problem with him. " We have so much rough land that can't be cultivated it is impossible to keep Paint Brush under control. Sheep will keep it down to some extent, but my sheep have been worried by dogs so much that I am half inclined to give up sheep entirely. I hope the Legislature will soon pass an act that will allow municipalities to regulate the keeping of dogs and to compensate the owner of sheep for any losses incurred from dogs. There is no use at the present time in any person attempting to keep sheep, there is no way of getting at the dogs or the dog owners."

"I have no trouble in killing Paint Brush," Mr. Edwards continued, "in land that can be tilled. Quack grass is worse than it. Just south of us here in New York state the farms are terribly infested with Paint Brush. I sometimes think that if we could get quack grass to grow in our pastures it would soon oust the

Paint Brush and at the same time furnish good feeding. I have not noticed much of the weed between here and Hemmingford."

In our drive from Franklin Centre to Ormstown we observed at intervals along the roadside considerable Paint Brush.

General Conclusions

We believe we are justified in drawing the following general conclusions from our many interviews with farmers who have had experience with Paint Brush both in pastures and cultivated lands, and from our own personal observations on infested farms in several counties :—

(1) Paint Brush is a most persistent weed in pastures and tends to crowd out the grasses by its habit of spreading over the ground by runners and by its leaf habit of lying close to the ground.

(2) The best farmers are able to control Paint Brush in land that can be tilled. Where good cultivation and a rotation of crops are practised this weed does not give serious trouble.

(3) Paint Brush, like many other weeds, is hard to dislodge from rough pastures that cannot be tilled. This phase of the situation gives farmers most concern.

(4) It is not enough to plow infested sod but once before sowing to oats. This treatment will kill a few of the weeds, but it stimulates the others present to greater activity. Too many farmers are practising this one-plowing method.

(5) When sod land infested with Paint Brush is plowed as shallow as possible just as soon as the hay crop is removed, then rolled and harrowed, then disc-harrowed thoroughly ten days later and cultivated at intervals until autumn, then plowed deeply just before winter sets in, the Paint Brush as well as many other noxious weeds will be pretty well exterminated. If corn or hoed crops follow the next year and continuous cultivation be given, not only Paint Brush but also quack grass will be killed.

It is important to enrich the land at this stage and when seeding down is done to give a heavy seeding of clovers and grasses—about twenty pounds per acre.

(6) Sheep will eat Paint Brush, and there is strong evidence that if a sufficient number are kept in rough pastures there will be little trouble from this pest. Much of the hilly infested land of the Eastern Townships can, we believe, be reclaimed by sheep pasturing.

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FIFTH ANNUAL REPORT

OF THE

Quebec Society for the Protection of Plants from Insects and Fungous Diseases

1912-1913

PRINTED BY ORDER OF THE LEGISLATURE

QUEBEC
LOUIS V. FILTEAU, KING'S PRINTER
1913

FIFTH ANNUAL REPORT

of the

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

from

INSECTS AND FUNGOUS DISEASES

1912-1913.

To the Honourable J. E. Caron, M.P.P.,
Minister of Agriculture,
Quebec.

Sir:-

I have the honour to present herewith the Fifth Annual Report of the Quebec Society for the Protection of Plants from insects and fungous diseases, containing proceedings of the winter meeting of the Society, which was held at Macdonald College, Ste. Anne. de Bellevue, Que. on the 27th of March, 1913.

Included are the papers that were read, and the reports of the officers of the Society.

I have the honour to be,

Sir,

Your obedient servant,

J. M. SWAINE,
Secretary-Treasurer.

Ottawa.
1913.

QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS

OFFICERS FOR 1912-1913.

President—Professor W. Lochhead, Macdonald College.

Vice-President—Mr. Auguste Dupuis, Director of Fruit Experiment Stations, Village des Aulnaies, P.Q.

Secretary-Treasurer—J. M. Swaine, Assistant Entomologist for Forest Insects, C.E.F., Ottawa.

Curator and Librarian—P. I. Bryce, Assistant in Biology, Macdonald College.

Directors—Rev. Dr. Thos. Fyles, Ottawa.
Rev. Father Leopold, La Trappe.
Rev. Father Victorin, Longueuil.
A. F. Winn, Esq. Montreal.
Prof. L. S. Klinck, Macdonald College.
Rev. Abbe Huard, Provincial Entomologist, Que.
G. Chagnon, Esq., Montreal.
Dr. Hamilton, Macdonald College.

Auditors—W. P. Fraser, Macdonald College.
Dr. Hamilton, Macdonald College.

Delegate to the Royal Society of Canada—Prof. Lochhead, Macdonald College.

Delegates to the Ontario Entomological Society—Mr. Chapais, St.Denis, Que.; Mr. Winn, Montreal.

MEMBERS OF THE QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS.

Arkell, H. S.	Dept. of Agr., Ottawa.
Blair, Prof. Saxby	Kentville, N.S
Bates, F. W.	Regina, Sask.
Benjamin, Rev. Bro.	La Trappe, Que.
Brittain, Wm.	Vernon, B.C.
Brown, F.S.	Dept. of Agr., Ottawa
Bryce, P.I.	Macdonald College
Buck, F.E.	Dept. of Agr., Ottawa
Campbell, Rev. Dr. Robt.	Montreal
Chagnon, George.	Montreal
Chapais, J.C.	St. Denis-en-bas, Que.
Cloutier, H.	La Trappe, Que.
Cowan, P. R.	Macdonald College
Cutler, G. H.	Saskatoon, Sask.
Dalaire, O. C.	St. Hyacinthe, Que.
Dash, J.S.	Macdonald College
Davis, M. B.	Yarmouth N. S.
Drayton, F. L.	Macdonald College
Dreher, W. C.	Dept. of Agr., Ottawa
Ducharme, Rev. George	Rigaud, Que.
Duporte, E. M.	Macdonald College
Dupuis, Auguste	Village des Aulnaies, Que.
Eastham, J. W.	Dept. of Agr., Ottawa
Edouard, Rev. Father	La Trappe, Que.
Emilien, Rev. Father	La Trappe, Que.
Fiske, H. J. M.	Macdonald College
Flewelling, D. B.	Fredericton, N. B.
Fraser, W. P.	Macdonald College
Fyles, Rev. Dr. Thos. W.	Ottawa, Ont.
Gibson, Arthur	Dept. of Agr., Ottawa
Grignon, Dr. W.	Ste-Adele, Que.
Gussow, H. T.	Dept. of Agr., Ottawa
Hall, Landon	Cowansville, Que.
Hamilton, Dr. D. W.	Macdonald College
Hammond, H. S.	Macdonald College
Harrison, Dr. F. C.	Macdonald College
Hewitt, Dr. C. G.	Ottawa
Honore, Rev. Father	La Trappe, Que.
Huard, Rev. Abbe	Laval University Que.
Husk, R. E.	Macdonald College
Jack, Norman E.	Chateauguay Basin, Que.
Jenkins, M. H.	Ottawa. Ont.
Klinck, Prof. L. S.	Macdonald College

Leopold, Rev. Father	La Trappe. Que.
Liguori, Rev. Brother	La Trappe, Que.
Lyman, Henry H.	Montreal
Lochhead, Prof. W.	Macdonald College
MacClement, Dr. W. T	Queen's University, Kingston, Ontario
MacFarlane, J. N. R.	Macdonald College
Moore, G. A.	Montreal
Nagant, H.	Quebec
Newman, C. P.	Lachine Locks, Que.
Raymond, A.	La Trappe, Que-
Reid, Peter	Chateauguay Basin, Que.
Reid, T.	Macdonald College
Richardson, B.	Macdonald College
Robinson, J. M.	Kentville, N. S.
Simard, S.	Dep. Agr., Quebec, Que.
Straight, E. M.	So. Portland, Me.
Summerby, R.	Macdonald College
Swaine, J. M.	Dept. of Agr., Ottawa
Tourchot, A. L.	St-Hyacinthe, Que.
Vanderleck, J.	Macdonald College
Victorin, Rev. Bro.	Longueuil, Que.
Winn, A. F.	Montreal
Wood, G. W.	Winnipeg, Man.

HONORARY MEMBER:

James W. Robertson, Esq., LL.D., C.M.G.

FINANCIAL STATEMENT
of the
QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS
FROM INSECTS AND FUNGOUS DISEASES

RECEIPTS.

Brought forward	$201.37
Provincial Government Cheque	250.00
Interest on Deposit to Dec. 31, 1912	3.73
	$455.10

DISBURSEMENTS.

Members' Expenses to Winter Meeting	$ 15.40
Expenses of Delegate to the Annual Meeting of the Ontario Entomological Society	19.45
Cost of Publishing the English Edition of Third Report	60.00
Postage	9.50
Secretary's Stipend	50.00
Cost of Publishing French Edition of Third Report do French and English Editions of Fourth Report	160.00
	$314.35
Balance, cash on hand, March 27th, 1913,	140.75
	$455.10

J. M. SWAINE,
Secretary Treasurer,
Wm. LOCHHEAD,
President.

Auditors:
W. P. FRASER,
P. I. BRYCE.

FIFTH ANNUAL REPORT
of the
QUEBEC SOCIETY FOR THE PROTECTION OF PLANTS.

Report of the Winter Meeting.

The Fifth Annual Meeting of the Quebec Society for the Protection of Plants was held at Macdonald College on March 27th, 1913.

The opening business meeting was called to order by the President, Professor Lochhead, at 2 p.m. There were present:-

Professor Lochhead, Macdonald College.
J. C. Chapais, St. Denis, Que.
Dr. C. G. Hewitt, Ottawa.
Bro. Benjamin, La Trappe.
Professor Klinck, Macdonald College.
W. P. Fraser, " "
P. I. Bryce " "
J. S. Dash " "
E. M. Duporte, " "
J. M. Swaine, Ottawa.

The minutes of the last meeting were read and approved.

The Report of the Treasurer was read and accepted.

The question of a new edition of Provancher's Flora was again discussed; and it was left with the President for further action.

Professor Lochhead spoke briefly of the recent death of one of our most valued members, Dr. John Brittain. Dr. Brittain had been a director of the Society from its foundation, and one of our active workers. An ardent student of Nature in many branches he was, moreover, a close personal friend of many of us, and his loss is deeply felt.

It was moved by Dr. Hewitt and seconded by Mr. Chapais that a message of sincere sympathy be sent to Mrs. Brittain, in the loss of her husband, our friend and colleague, Dr. Brittain.

The matter of obtaining new members was discussed. The active workers in the Society are few in number; and it was felt that an effort should be made to obtain the support of all workers in Biology in the province, particularly those connected with educational institutions.

Mr. Winn's List of the Lepidoptera of Quebec which was published as a supplement to the Fourth Annual Report received much praise. It is hoped that the remaining Orders wil receive similar treatment.

It was arranged to send a delegate to the Annual meeting of the Royal Society of Canada, with which Society we are now affiliated.

It was further agreed to send two delegates to the Annual Meeting of the Ontario Entomological Society to be held at Guelph, Ont.

The following officers were elected for the ensuing year:-

President—Professor Lochhead, Macdonald College.

Vice-President--M. Auguste Dupuis, Director of Fruit Experiment Station, Village des Aulnaies, P. Q.

Secretary-Treasurer—J. M. Swaine, Assistant Entomologist for Forest Insects, Ottawa.

Curator and Librarian—P. I. Bryce, Assistant in Biology, Macdonald College.

Directors —Rev. Dr. Thos. Fyles, Ottawa.
Rev. Father Leopold, La Trappe.
Rev. Father Victorin, Longueuil.
A. F. Winn, Esq., Montreal.
Prof. L. S. Klinck, Macdonald College.
Rev. Abbe Huard, Provincial Entomologist, Quebec.
G. Chagnon, Esq. Montreal.
Dr. Hamilton, Macdonald College.

Auditors—W. P. Fraser, Macdonald College.
Dr. Hamilton, Macdonald College.

Delegates to the Ontario Entomological Society—
Mr. Chapais, St. Denis, Que.
Mr. Winn, Montreal.

The Business Meeting then adjourned.

The general meeting was called to order in the lecture-room of the Biology Building, at 3 p.m., by the President, Professor Lochhead. Dr. Hewitt, the Dominion Entomologist, was present, and took an active part in the discussion of the papers. In addition to the members of the Society many students were present at the meetings.

In a short address Dr. Harrison welcomed the visiting members to Macdonald College, and had many kind words for the good work that was being accomplished by the Society

. At the afternoon and evening sessions many excellent papers were read and discussed. These appear in the body of the Report.

THE PRESIDENT'S ADDRES

By Professor W. Lochhead, Macdonald College.

Fellow Members:-

I have again the honor of welcoming you to our Fifth Winter Meeting. I trust you will find the programme of addresses by prominent workers which has been prepared both interesting and instructive. We are deeply indepted to the Hon. Mr. Caron for the grant which enables us to meet here and to publish our Annual Report.

Since our last meeting our fourth report has been published and distributed. As an appendix to the report Mr. Winn's Preliminary List of the Lepidoptera of the Province of Quebec appeared about the same time. I have received many letters of a congratulatory nature regarding both the main report and Mr. Winn's list. It is hoped that the fifth report will have an appendix containing a list of some other order of insects.

In my last address to this Society I called attention to the pressing need for the investigation and solution of certain problems in Economic Biology—for example, the control of the Plum Curculio, the Apple Maggot, the Black Rot Canker and Potato Scab. Since then the division of Entomology has stationed one of its officers, Mr. Petch, at Covey Hill for the express purpose of investigating the life history of the Plum Curculio and other serious orchard pests. I hope this is but the beginning of a number of field investigations for there is also a need for a careful study of the fungous diseases of field, orchard and vegetable crops.

INJURIOUS PESTS IN QUEBEC IN 1912.

Permit me in this connection once more to draw public attention to the presence of the **Potato Canker** in Canada. Last summer this serious European disease of potatoes was found to have entered Canada through shipments of potatoes from England, as diseased tubers were discovered in one or two districts in Ontario and Quebec. It would be a great calamity if the Potato Canker should get a foot-hold in Canada, especially in the potato growing districts. As members of this Society we should do everything in our power to call the attention of the public to the threatening danger.

A concise description of this disease will be found in our last report.

During May and June last year Tent Caterpillars were very abundant and did a great amount of damage over large areas of the Province. An examination of the egg masses in late fall and winter showed practically an absence of parasites, so there is every likelihood that the Tent-Caterpillars will be even a greater scourge in 1913 than they were in 1912.

The Spruce Bud-Worm continues to devastate the spruces of the lower St. Lawrence, and it is to be hoped that its parasites will soon bring relief.

New Provincial Entomologist & Publications.

It is a pleasure for me to refer to an important step in advance that has been taken by the Minister of Agriculture for the Province of Quebec since our last meeting. The Rev. Abbe Huard, Curator of the Provincial Museum at Quebec, has been appointed Provincial Entomologist. I regret that his absence in Washington and New York at this time prevents his attendance at this meeting. I am sure the Society joins me in congratulating the Minister on the creation of the new office of Provincial Entomologist, and the Rev. Abbe Huard on receiving the appointment to this responsible position.

I would also call the attention of the Society to the recent appearance of a new publication entitled "The Review of Applied Entomology," issued by the Imperial Bureau of Entomology, London, Eng. This Review forms a sort of Clearing House for all work done in Entomology throughout the world for the use of workers in the British Empire.

I should not omit mentioning here two new American entomological publications of the nature of text books, viz. "Elementary Entomology" by Sanderson and Jackson, published by Ginn & Co.; and "Injurious Insects" by W.C. O'Kane, published by the Macmillan Co. Both books will serve a useful purpose, the former as an introduction to the science and the latter as a reference guide to the insects that are injurious.

PARASITIC INSECTS IN THE CONTROL OF INJURIOUS FORMS

By Professor W. Lochhead, Macdonald College.

During the last ten years much effort has been expended in the United States in attempts to control certain noxious insects, notably the Gypsy and the Brown Tail Moths, by the introduction of parasitic forms from Europe and Japan. The scientific world is interested in this work on account of the magnitude of the operations and the difficulties to be overcome, and of the probable far-reaching influence in the control of other noxious insects.

It seems to me, therefore, that not only the members of this Society but also the people of Quebec should be informed as to the progress that has been made by entomologists in the control of injurious insects through the introduction of parasitic forms. The following account is based largely on a report prepared by Howard and Fiske of the U. S. Bureau of Entomology (Bulletin 91), and on a report by Dr. F. Silvestri of Italy, entitled "A Survey of the Actual state of Agricultural Entomology in the United States of America."

A SHORT HISTORY OF INSECT PARASITISM.

From early times students of insect life have observed that sometimes from caterpillars and their chrysalids there emerge insects that are different from them and that often cause their death. According to Silvestri, Aldrovandi (1602) was the first to observe the exit of the larvae of Apanteles glomeratus, which he thought were eggs, from the common cabbage caterpillar. Later, Redi (1668) recorded the same observation, and another on insects of different species.

Valisnieri (1661-1730) was probably the first to discover the real nature of parasitism Reaumur (about 1735, and De Geer about 1760) published records of many parasitic forms. About the beginning of the 19th century considerable attention was given to the study of insect parasites by several Zoologists, and many records were published. Ratzeburg's great work on "The Ichneumons of Forest Insects," published about 1850, was for a long time the great classic on the subject. During the last part of the 19th century Entomologists of many countries made important contributions so that by the end of the century the literature on the subject was quite voluminous.

The economic use of parasitic insects naturally shows three phases: —

(1) The utilization of the native parasites of the district;

(2) The transportation of the parasites from one district to another; and

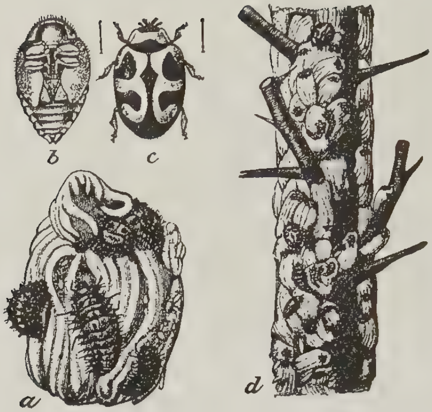
(3) The importation of parasites from one country to another.

(1) In the great majority of cases of insect outbreak the native parasites are able to control it in time. In fact injurious forms are mainly held in check by their parasites. Occasionally however, through the operation of some obscure factor, the multiplication of parasites is prevented; then the injurious forms are permitted to reproduce with much less check and much loss occurs before parasites are able to "catch-up" again. Several prominent entomologists have called attention to the need for taking greater care of parasites. C. V. Riley urged that measures be taken to permit the parasite of the Rascal Leaf Crumpler and of the Bagworm to escape from the winter nests. Comstock made a similar recommendation with regard to the chrysalids of the imported cabbage worm and the Cotton Caterpillar. Decaux in France advised preserving apple buds attacked by the Anthonomus weevil in boxes covered with gauze so as to allow the parasites to escape. It is said that he carried out his plan in 1880 with great success.

Several cases are on record where outbreaks have been successfully treated by the use of beneficial insects. Boisgiraud of France in 1840 controlled a plague of Gipsy caterpillars by placing among them the carabid beetle, Calosoma sycophanta.

(2) Some successes have been reported where parasites were transported from one locality to another. LeBaron of Illinois in 1872 introduced Aphelinus mali a parasite of the Oyster Shell Scale. Webster in 1907 transported Polygnotus hiemalis from Marion, Pa., to a field of wheat infested with Hessian Fly at Sharpsburg, Md., and observed that later in the season every 'flax-seed' was parasitized. W.D. Hunter introduced parasites of the Cotton Boll Weevil from Waco to Dallas and from Texas to Louisiana with considerable success.

(3) Several conspicuous successes have attended the importation of parasites from foreign countries. Perhaps the introduction of **(a) Novius cardinalis** from Australia to California in 1888 for the purpose of controlling the Cottony Cushion or Fluted Scale of the Orange (Icerya purchasi) is one of the most interesting cases. This scale was brought to California about 1868, probably on Acacia latifolia. It began to multiply rapidly in the orange and lemon groves in spite of every measure that was tried against it. Riley, U. S. entomologist, and his staff made the scale a subject of special study for four or five years and he became convinced that it was a native of Australia. Accordingly, two entomologists, Koebele and Webster, were sent to that country to collect possible parasites, and to send them to California. Novius cardinalis was found at Adelaide and small shipments of it were sent. The Lady-birds began to feed on the Icerya scale insect as soon as they were liberated, and to breed rapidly—the result being that within a year the orange growers confessed that their groves had been saved.



Novius Cardinalis.

The Australian Lady-bird (Novius cardinalis) ; A. larvae feeding on fluted scale ; B. pupa ; C. adult lady-bird ; D. orange twig, showing scales and lady-birds (after Bull. 91. U.S. Dep. Agric.(

Later, Novius cardinalis was sent to New Zealand, Portugal, Cape Colony, Florida, Hawaiian Islands, Italy, Syria and Egypt, and equally good results were secured. Silvestri gives the reasons for this success as follows: (1) Novius can produce in one year double the number of generations that Icerya can; (2) Novius feeds preferably on eggs of Icerya; and (3) the absence of parasites of Novius.

(b) Another interesting example of successful parasitism through importation in 1901 is that of **Scutellista cyanea,** a chalcid insect from South Africa to control the Black Scale of the Olive (Lecanium oleae) of California.

(c) The efforts of Mr. Marlatt in 1902 to introduce **Chilocorus similis** from China to the Eastern United States for the control of the San Jose Scale did not meet with success on account of adverse climatic conditions and the general practice of spraying infested orchards with lime sulphur mixture.

(d) The West Indian Peach Scale (Diaspis pentagona) occurs in the Southern States but is not very injurious on account of the presence of a parasite, **Prospaltella berlesei.** Specimens of the parasite were sent to Italy where mulberry plantations were seriously injured, with the result that it is now well established and holding the scale in check.

(e) In 1908 the **Egg parasite** (Tetrastichus xanthomelaenea) **of the Elm Leaf Beetle** (Galerucella luteola) was introduced into New England from France. The success of the experiment is not yet assured, although the parasite was observed to have multiplied and spread slightly during the same year.

(f) Compere travelled much in foreign countries in an effort to sesure parasites of the Codling Moth and the Mediterranean Fruit-Fly (Ceratitis capitata). In Spain he collected an Ichneumon, **Calliephialtes messor,** a parasite of the Codling Moth, and sent it to California, where it has been reared with great success. However, it has not done well in the field, and the Codling Moth has not been reduced to any extent.

(g) In Brazil Compere found an Ichneumon fly and a Staphylinid beetle feeding on the fruit-fly larvae. These he collected in large numbers and sent them to Australia, and in his optimism shouted "Victory," prematurely. In India he collected parasites of the Dacus, a fly related to Ceratitis, and bred them in large numbers in Western Australia, but whether they are able to control the fruit fly or not we have not heard.

(h) In July, 1910, the Bureau of Entomology sent R. S. Woglum to Europe and Asia in an attempt to find parasites or satisfactory predatory enemies of the White Fly of the Orange (Aleyrodes Citri). Mr. Woglum found that in India the White- Fly was killed by a **fungous dissease, Aegerita Webberi,** attacked by two coccinnellids, **Veranta cardoni** and **Cryptognatha flavescens,** and parasitized by an Aphelinid **Prospaltella Lahorensis.** Unfortunately the parasites and the lady-birds died during the winter season in Florida, before it was possible to determine their possible efficiency.

Many other cases along the foregoing lines might be cited, but enough have been given to show that the plan of utilizing the parasitic enemies of injurious pests is feasible, and in some instances the most effective ways of dealing with imported pests.

We should remember that the Novius cardinalis success has never been duplicated and that it stands out as an historical event in applied entomology. At the same time it has resulted in giving a great stimulus to the efforts to bring about insect control by means of natural enemies.

The Gipsy Moth in New England

The Gipsy Moth (Porthetria dispar L.) was introduced accidentally at Medford, Mass., in 1868 by Professor Leopold Trouvelot. A few specimens kept by the Professor for silk-worm study escaped, and becoming acclimatized began to increase. The alarm was duly given, and Dr. Riley, then Entomologist for Missouri, refers to the progress of this colony of imported moths in two of his reports. However, the spread of the insect was slow during the first ten years but during the the second ten years (1879-1889) the increase was quite marked and the inhabitants of Medford, Melrose, Malden and other towns became alarmed. In 1889 Prof. C. H. Fernald of the Massachusetts Agricultural College published a special bulletin in which he gave a description of the different stages of the Gipsy Moth and advised treatment by spraying with Paris Green.

By 1890 about 20 towns in Massachusetts had become affected, and the State authorities were obliged to take decided action in an attempt to control the pest. From 1890 to 1897 large annual appropriations were made, totalling $1,200,000, in an effort to exterminate the moth. It was believed at this time that the native parasite forms "might gradually accommodate themselves to the imported pest, and prove prominent factors in the fight against it."

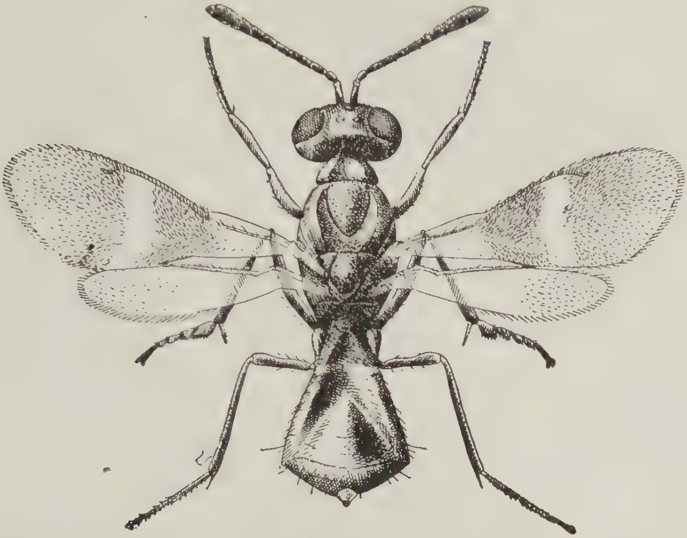
This campaign confined the moth to certain limits, but did not exterminate it. Unfortunately the State appropriations ceased in 1899 and the fight was left to the affected towns to carry on. During the next five years the moth spread rapidly and the State authorities were again compelled to take action. The Federal Government also came to the State's assistance, and in 1905 a further attempt was made to control the pests by the introduction of parasitic forms from Europe and Japan. Dr L.O. Howard, chief of the Bureau of Entomology, Washington, gave special attention to this phase of the work. He paid three or four visits to European countries, notably France, Belgium, Italy, Germany, Russia and Austria, for the purpose of getting qualified persons to send large quantities of the eggs, larvae, and chrysalids of both the Gipsy and the Brown Tail Moths, which are usually parasitized in Europe, to the special laboratories that had been erected near Boston. On the arrival of the packages at the laboratories the assistants in charge opened them in completely closed receptacles so as to prevent the escape of possible secondary parasites, and the material was placed in cages or boxes for the breeding of the parasites.

The Control by Parasites

The problem of the control of the Gipsy Moth by parasites is a more difficult one than appears on the surface. From extensive studies of the life history of the moth it has been determined that the probable potential rate of increase is 250-fold annually. On account, however, of the heavy death rate from various causes the actual rate of increase is only from 6 to 10-fold.

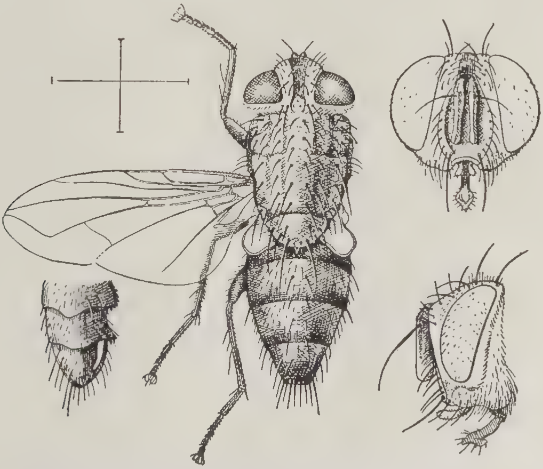
The problem was then to secure sufficient parasites to keep the insect in control. In other words, if the increase annually be 6-fold, five out of every six insects, either egg, caterpillar, or pupa, or 83.3 per cent would require to be parasitized.. If the increase be 10-fold, nine out of every ten, or 90 per cent, must be parasitized. To rely entirely upon egg parasites, such as Anastatus or Schedius, to destroy such a large precentage of the eggs was out of the question, for these parasitized only the upper layer of eggs in each mass. It became necessary, therefore, to call in the aid of the parasites affecting the caterpillar and the pupa. Consequently efforts have been made to secure a sequence of parasites from foreign countries so that every stage of the moth is subjected to attack, and which would bring up the death-rate to 85 or 90 per cent.

(1) As an egg parasite of the Gipsy Moth, **Anastatus bifasciatus** a chalcid, takes first place. One drawback is its low powers of distribution, about 250 feet per year, and its power to parasitize only the upper layer of eggs in the mass which is usually three layers in thickness, so that artificial dispersion becomes necessary.



Anastatus bifasciatus, adult female. An egg parasite of the Gipsy Moth, greatly enlarged (from Howard)

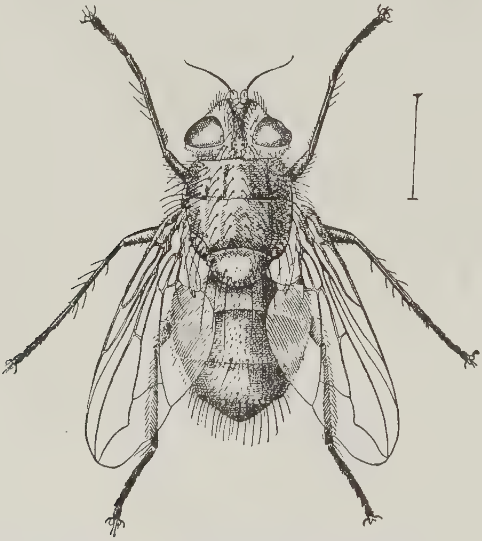
(2) The egg parasite, **Schedius Kuvanae,** also a chalcid obtained from Japan, does not give promise of being able to withstand the winter conditions.



Compsilura concinnata, adult female and details, much enlarged (Bull. 91, U.S. Dep. Agric.)

(3) **Compsilura concinnata** attacks the caterpillars of both the Gypsy and the Brown tail Moths It is a tachinid, and the mother fly deposits the young maggots beneath the skin of the host. The maggots mature in two weeks, when they make their exit and usually drop to the ground for pupation. In another week the adults emerge and in three or four days begin producing young. This important parasite was introduced in 1906 and 1907. In 1909 it was found generally distributed over a considerable area, and in 1910 a marked increase in numbers was noted.

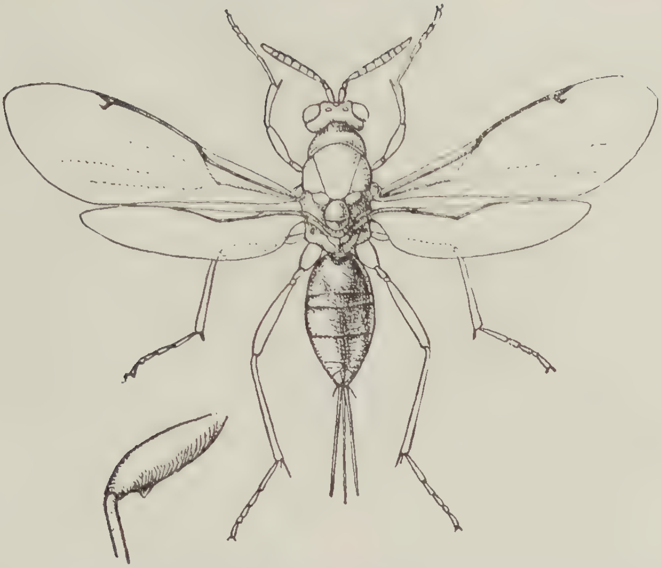
(4) **Blepharipa scutellata** is another tachinid of importance. Its habits differ from those of Compsilura in that the eggs are deposited upon foliage in order that they may be devoured by the host.



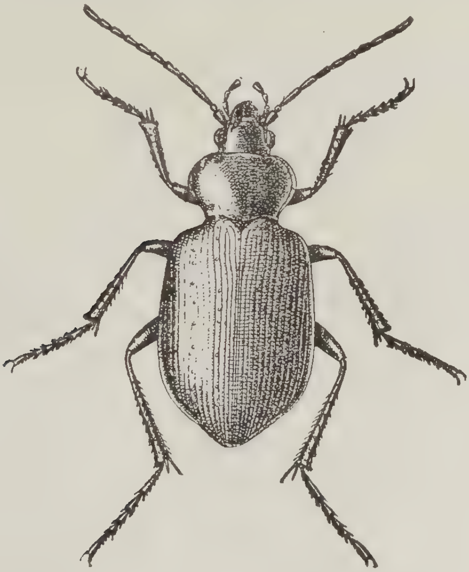
Blepharipa scutellata, adult female, enlarged (Bull. 91, U.S. Dep. Agric.)

(5) **Monodontomerus aereus,** a chalcid, is a parasite of the pupa of both the Gipsy and the Brown-tail moths. Curiously enough it is commonly reared as a secondary as well as a primary parasite. Consequently its status as a control factor is difficult to determine. It is a secondary parasite upon tachinids and upon Apanteles lacteicolor.

(6) **Calosoma sycophanta** is the most effective predaceous beetle against the gipsy moth. Both adults and larvae are predaceous and freely climb trees in search of their prey. The eggs are deposited in the earth and the full-fed larvae seek the earth again and construct pupal cells. The adult beetles do not emerge until late in the spring. The breeding season coincides almost exactly with the caterpillar season. It is found generally distributed, is firmly established, and is increasing and dispersing rapidly.



Monodontomerus aereus, adult female. A parasite of the Gipsy and Brown-tail Moths. Greatly enlarged. (Bull 91, U.S. Bur. of Ent.)



Calosoma sycophanta, a valuable predaceous enemy of the Gipsy and Brown-tail Caterpillars.

That this and other not mentioned parasites are making their presence felt may be realized when it is stated that fully 50 per cent of the eggs, caterpillars or pupae of the gipsy moth were destroyed by imported parasites in 1912, in the central region infected.

The Brown Tail Moth

The Brown-tail Moth was probably introduced at Somerville in Massachusetts in 1890 in shipments of roses from Europe where it has long been a serious pest. It did not attract attention till 1897 when action was taken to control it along with the Gipsy Moth. In spite of the efforts however it has spread into Maine and New Hampshire, New Brunswick and Nova Scotia, and is even more injurious and abundant in Massachusetts than the Gipsy Moth itself. On account of the fact that both the female and the male moths are good fliers its spread has been rapid.

Observations showed that while the Brown-tail Moth is attacked by certain native parasites and predaceous insects the percentage of parasitism and destruction is extremely small. It became necessary, as in the case of the Gipsy Moth, to import those parasites that keep the Brown-tail in check in Europe.

THE CONTROL OF PARASITES.

It is rather remarkable that no effective parasite of the egg of the Brown-tail Moth has been imported, but there are four important imported parasites of hibernating caterpillars.

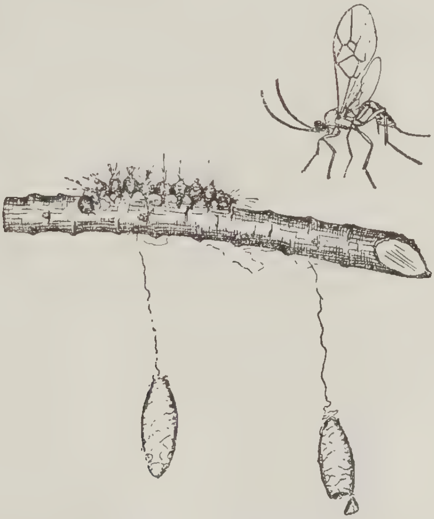
(1) **Pteromalus egregius,** a chalcid. The females enter the nest in the fall and deposit their eggs on the dormant caterpillars. The larvae feed externally. It is now generally distributed over very extended territory and apparently well established.

Pteromalus egregius, adult female and a parasite of the Brown-tail moth, much enlarged.
(Bull 91, U.S. But. Ent.)

(2) **Apanteles lacteicolor,** a braconid, attacks the small caterpillars in the fall before they enter their winter nest. In the spring the parasite larva issues and spins a white cocoon within the molting web. It is now generally distributed over a considerable area.

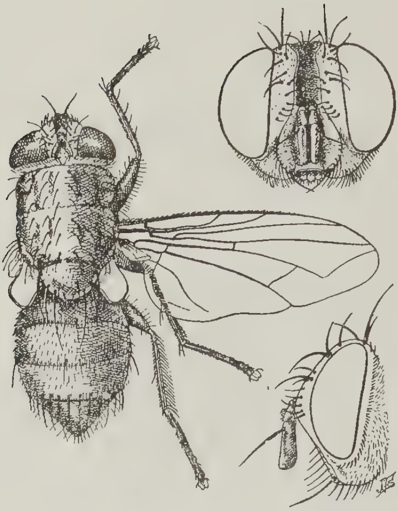
Apanteles lacteicolor, adult female and cocoon. A parasite of the Brown-tail Moth, much enlarged. (Bull. 91, U.S. Dep. Agric.)

(3) **Meteorus versicolor,** a braconid, has habits like those of Apanteles, but the cocoons swing from long threads. The adults issuing from them attack the large caterpillars for a second generation. Meteorus is now widely distributed and well established.



Meteorus versicolor, adult female and cocoons. A parasite of the Brown-tail Moth, much enlarged. (Bull. 91, U.S. Dep. Agric.)

(4) **Zygobothria nidicola,** a tachinid, has hibernating habits like those of Apanteles and Meteorus. There is but one generation. It is now well distributed and apparently established.

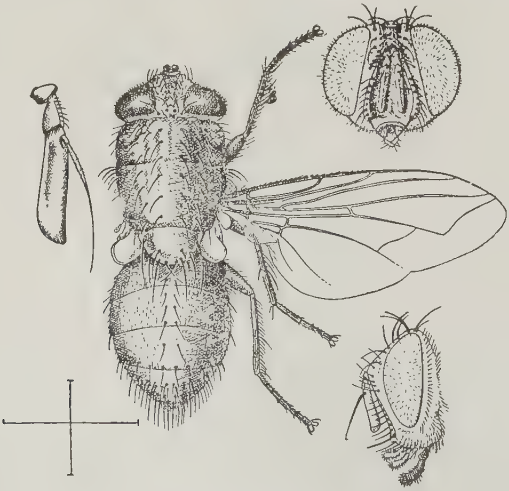


Zygobothria nidicola, adult female with details of head. A parasite of Brown-tail Moth, much enlarged.
(Bull. 91, U.S. Dep. Agric.)

(5) As already mentioned, the **Compsilura concinnata** tachinid attacks the larger caterpillars of the Brown-tail and is one of the most satisfactory.

(6) **Dexodes nigripes**, a tachinid, is very like Compsilura concinnata in appearance. It was well colonized in 1906-07, but it has not been recovered in the field to any extent.

(7) **Pales favida** is a promising tachinid parasite. Its eggs are eaten by its host. Its life history has been worked out by Mr. W.R. Thompson, a Canadian working at the Parasite Laboratory.



Pales favida, adult female with details of head. A parasite of the Brown-tail Caterpillar, much enlarged.
(Bull. 91, U.S. Bur. Ent.)

(8) **Monodontomerus aereus,** a Chalcid, as already mentioned, is a parasite of the pupa of the Brown-tail as well as the Gipsy.

(9) **Pimpla instigator,** an Ichneumon, was introduced from Europe, but has not been recovered from the field.

Among the native parasites of the Brown-tail in America are:-

Trichogramma pretiosa,	a chalcid egg parasite,
Anomalon exile,	a caterpillar parasite,
Theronia fulvescens,	an Ichneumon,
Pimpla conquisitor,	on pupae,
Chalcis compsilurae,	on cocoons,

but as already stated, the control is inadequate.

CONCLUSION.

The task of importing the foreign parasites of the Gipsy and the Brown-tail moths to the United States has been a most arduous and difficult one. In the first place it involved much labor in getting competent collectors in Europe to gather sufficient parasitized material, for, as I have already stated, the plan of the utilization of foreign parasites on a large scale in the control of injurious forms is recent in conception, and was put into operation for the first time by the U.S. Bureau of Entomology in the fight against the Gipsy and the Brown-tail Moths. In the second place, many difficulties in transportation had to be overcome. In the third place, the work of sorting out the various parasites and herding them in sufficiently large numbers in the laboratories for colonization purposes in the field was much greater than was anticipated at the outset. In the fourth place, the habits of many of the parasites were not well known, and had to be determined for American conditions. As a result, many of the parasites reported favorably in Europe were found to be secondary parasites, or unsuited for the task in hand.

While we must admit that the importation of the foreign parasites of the Gipsy and the Brown-tail Moths has been successful, we should not conclude that these pests are now under control. It will take several years for the parasites to spread to the limits of the infested areas, and in the meantime the pests will go on spreading unless other measures are taken to check them. Much can be done to hasten the spread of the parasites by artificial colonization, as is being done at Fredericton, N.B. by Mr. Tothill, as agent of the Division of Entomology at Ottawa. The fight is by no means over; the pests must be fought by artificial means until the parasites are sufficiently abundant to destroy 85 to 90 per cent of them.

The improvement in Massachusetts "is due to at least four main causes: (1) the perfection and standardization of the methods for artificial repression; (2) the death of a large proportion of the more susceptible trees or their removal from the infested woodlands; (3) the importation of parasitic and predatory insect enemies; and (4) the development of the "wilt" disease" (Fiske).

WINTER INJURY IN ORCHARDS.

By F. M. Clement, Macdonald College.

Winter injury to fruit trees appears in many different forms and on all parts of the tree including the roots, but to-day we are particularly interested in that form which during the last few weeks has made itself manifest on the trunks of certain varieties of apple trees in one of the experimental blocks. In late January and early February the trunks of some of the trees in certain rows in block six were noticed to be splitting on the south and south-west side. At first it was not thought to be serious but later when the injuries or splits became more prominent, some as much as eighteen inches in length and one-half inch in breadth, it was decided to study the question a little more closely and detect, if possible, the cause or causes. Such wounds in themselves are quite serious, especially when desiccated from long exposure to wind and sun, but they are made doubly serious if not treated to prevent the admission of the spores of Saprophytic Fungi and especially Black Rot spores with the consequent development of apple canker. As yet no serious disease has gained a foothold in the orchard, and it is hoped that with careful treatment the damage will not prove to be as great as the injuries at present indicate.

All normal growing trees contract on freezing in degrees varying with the changing temperature. In the Geneva experiments it was found that eight apple trees of different varieties contracted from 1.7 per cent to 3.1 per cent—an average of a little more than 2 per cent between the greatest extremes. It has generally been supposed that the wood and bark of growing trees, like water, expands on freezing, and that the splitting is caused by the increased bark tension due to this expansion; but as I understand the question from observation and reading the results of the Geneva experiments, the co-efficient of contraction or expansion of bark on freezing is greater than the co-efficient of expansion or contraction of wood on freezing; also bark being exposed freezes more quickly; consequently an opening or split must occur if the tension is to be relieved. Or it may be explained thus: the co-efficiency of expansion or contraction of the circumference is greater than the co-efficiency of expansion or contraction of the radius, consequently splitting must occur when the expansive force becomes greater than the cohesive powers of the wood particles (Geneva Bulletin 23, including report from German investigations). In such cases cracks sometimes appear in the wood also.

It is also interesting to note that these tests indicate that contraction is greatest at lowest temperatures or increases with the fall in temperature. From 6.6°C to 9.4°C the average rate of contraction was .19 mm per degree of change of falling temperature while from 9.4°C to 28.3°C it was 46 mm per degree or about 2 1-2 times as great. This is also in accord with our own observation, which show the injuries or splits to be wider and more pronounced on the coldest days, closing, some wholly, some partly, and a few where the bark is badly loosened not at all on the warm days.

From our observations the following facts may be noted:

(1) The injured trees are in the sod mulch vs. clean cultivation experimental block, and in no other part of the orchard was any injury noted. Ordinarily trees in sod show no such injury.

(2) Nearly all the Fameuse, about two thirds of the Pattern's Greening and about 1-3 of the McIntosh in the block were injured. Small splits in one Arabka and one Wolf River were also noted. The remaining varieties in the block were apparently uninjured—Alexander, Milwaukee, Wealthy, La Salle, Duchess and Yellow Transparent.

(3) The trees in other blocks cultivated similarly, that is clean cultivation followed by a cover crop, showed no signs of injury.

(4) The early part of last season was comparatively wet. June was comparatively dry, while the remaining part of the season even till the last of November was wet. This would tend to produce late growth of a tender nature, as exemplified by the late falling of the leaves on the late growing and ripening varieties.

(5) The injured trees are all on a southern exposure and consequently would be more influenced by the sun's rays than those on the level or a northern exposure.

(6) The average temperature for January last was 22.15°F. The average temperature for the last few years was 12.60°F. This year therefore shows an increase of 9.55° over the average of a number of years.

On 4 days the temperature rose above 43°F, the minimum growing temperature, on 14 days the temperature rose above the freezing point, and on 4 days it did not freeze at all.

February on the contrary shows an average temperature of 10.1°F compared to 11.7 on an average for a number of years, a decrease of 1.6 degrees. On but one day did the temperature rise above a freeze. Six of the seven days of the second week in February showed a temperature of from 5 to 11 below zero. It was just at this time that the trees were first noticed to be splitting badly.

(7) Southern and western slopes expose trees to the prevailing winds. The south winds in particular are very desiccating.

(8) The loosening of the bark from the trees is apparently caused as much by the swaying of the trunk limbs and branches when the ground is frozen as by freezing and thawing. The situation where most damage occurred is the most exposed in the orchard.

Bernbeck, a German investigator, found "that transpiration was proportional to the wind rate and to the amount of bending or swaying undergone by plant structures and that the excessive loss of water ceased when bending was eliminated." Experiments to prove the statements are quoted in Geneva Bulletin 23, page 55. The experiments quoted also indicate "That rigidity seems to afford total immunity from wind injuries, while swaying or bending results in injury."

From the above observations I draw the following conclusions:
1. Exposure to the prevailing wind and the direct rays of the sun are factors of more importance in this section in preventing bark splitting than are cultivation and cover crops. Only trees on southern exposures are affected. The remedy then is apparently to use a northern exposure, or if this is not available at least a level field, and then to protect from the wind and sun still more by heading as low as possible.

WINDBREAKS.

Wrapping the tree trunks with building paper or wood veneer in early winter should give some protection.

In early February as soon as the first splits were noticed about thirty five trees were carefully wrapped with building paper, the paper being cut in strips about six inches wide, wrapped round the trees, and tied just below the branches. Thirteen of these protection papers were removed yesterday, March 26th, and in no case where the tree was undamaged when the paper was applied was injury noted. One or two trees that were badly damaged when the papers were put on showed still further damage but the wounds were comparatively clean and white. What further injury will occur or what effect the present injuries will have on the health and vigor of the trees I am not prepared to say, but the trees are being examined regularly and a careful report will be made later.

The usual treatment for such wounds will be applied in early spring, that is, all loose, dead bark will be removed and the wound covered with grafting wax.

The injuries I have mentioned I believe to be the primary cause of the development of Black Rot Canke and Crown Rot in apple trees, and consequently only by the prevention or careful treatment of them can these two serious forms of disease be controlled.

THE SAW-FLIES OF THE PROVINCE OF QUEBEC.

Rev. Thomas W. Fyles, D.C.L., Ottawa.

Tenthredinina.

"One sex only bears a weapon
Near the tail, beneath the body,
Sharply notched and very sawlike,
And with this she quickly pierces
A young leaf or juicy sucker,
And her eggs sedately places
In the wound she hascreated;
From this saw we call them saw-flies.
Saw-flies or Tenthredinina."

Newman, THE INSECT HUNTERS, p. 34

A formidable battalion in the host of insects injurious to vegetation is presented by the Tenthredinina which are commonly known as Saw-flies. They derive their familiar name from a remarkable provision, found at the end of the abdomen, in the females of the various species. This consists of a double saw contained in a cleft. The blades of this are placed side by side and are toothed on the outer edge. They can be protruded, and worked backward and forward, and withdrawn when not in use. With these instruments the mother fly cuts little slits in the leaves or tender twigs of plants to form receptacles for her eggs.

One beautiful August day in the year 1897, I was strolling through a grove of aspen poplars on the heights of Levis, when my attention was taken by some streaks of light on the underside of a leaf that quivered above me. I found that these streaks were reflections of the bright sunshine from the upturned edges of incisions through the epidermis of the leaf. I knew the wounds had been made by a saw-fly which had deposited an egg in each of them. The larvae in breaking away had raised the edges of the wounds, and then had wandered off. I made a search for the stragglers and soon found them. In a number of leaves near by round holes were bitten; and, extended along the edge of each of these was a thread-like larva. The creatures belonged to the species **Amauronematus luteotergum** Norton.

(For description of the full grown larvae and imagos of these insects see the 28th Annual Report of the Entomological Society of Ontario. page 73).

The wounds made by some species of saw-flies cause an abnormal growth which takes the form of galls on the food-plants of the species. The rosy, kidney-shaped galls so abundant on the white willow are familiar to us all. Sometimes as many as twenty of these galls are seen on one leaf. They result from the operations of the fly **Pontania (Messa) hyalina** Norton.

Some years ago I sent specimens of the galls of this species and of the perfect insects to an English hymenopterist, Mr. Edward A. Fitch. He wrote to me from Malden, Essex, on the 29th of May, 1885, saying-

"The saw-fly I have but little doubt is identical with our British **Nematus gallicola** West (**Vallisnerii** Hart) as far as I can judge from the female and gall sent.

The larvae of the species dwell in the galls till the approach of winter, each finding its habitation to be a fortalice well stored with food. When the leaves fall, the larvae bite openings to the outer air, descend into the earth, and there spin for themselves cocoons, in which they remain till the winter is past. The perfect flies appear when the leaf buds of the willow are about to open.

I have shown in the 3rd Annual Report of our Society that the English sparrow is a foe to this saw-fly.

Of other species that affect the willow I have taken two new kinds, in Quebec Province, viz:—**Petronus harringtoni** Marlatt, and **Pteronus fylesi** Marlatt. Both are fully described in Marlatt's **Revision of the Nematinae of North America,** p.p. 53 and 54.

The largest of our saw-flies is **Cimbex americana** Leach It is an inch and three quarters in expanse of wings, and five-sixths of an inch in length of body. The typical insect has head, thorax and legs of a dark brown, abdomen chestnut-colored, antennae and feet yellow. Its wings are clear but all have a light-brown shade along the hind margin. The venation of the wings is brown and very distinct.

The larva of this insect feeds on the willow and other trees. It is an inch and a half, or more, long, of a pale greenish yellow, with a black dorsal line and black spiracles. It has the habit of curling itself helix fashion; and in this form it may often be found at the foot of its food tree. This larva has 22 legs—six more than the caterpillar of a butterfly.

The numbers of **Cimbex americana** are kept down by a large and handsome ichneumon fly, **Opheltes glaucopterus** Linn.

No less than eight named insects have been related by Cresson in his "Synopsis of the Hymenoptera of America, North of Mexico" to **Climbex americana.** One of them, **Climbex ulmi** Peck, is fully described in Harris's "Insects Injurious to Vegetation," p. 519. It is a very handsome insect. Peck found it feeding upon the Elm (Ulmus) but that is not its only food-plant. I found it on the Paper Birch (Betula papyracea Ait) season after season at South Quebec.

Another fine variety of Cimbex is the **Cimbex decem-maculata** of Leach. This has a dark abdomen with five yellow blotches on either side. In some instances the blotches extend upwards till they nearly meet on the dorsum. In these instances the insect reminds one of the **Climbex lutea** of England.

On the 3rd of June, 1903, I found a peculiar form of Cimbex under remarkable circumstances. I had visited the Gomin Swamp; but dense smoke from forest fires filled the atmosphere, and the sun, when it showed itself at all, was like a copper disk—there was nothing on the wing. I walked down to Sillery, intending to take the New Liverpool boat to the city, but so thick was the gloom that the captain of the boat was afraid to make the trip. I then took the ascent to the Plains of Wolfe's Cove. Half way up the steep I found the insect I am telling of, lying upon its back. It hadthe general outline of **C. Americana;** but its head, thorax, abdomen and wings were all of a deep purple. So dark were the wings that the venation could be traced only with difficulty. The antennae and feet were yellow, as in **Americana.** I do not know that anyone has named this insect: to distinguish it in my list I will call it **Obscura.**

Trichiosoma triangulum Kirby is an insect somewhat resembling **Americana** but smaller and hairy (Hence the generic name TRICHIAS, ou ô, one that is hairy, Gr., and Soma, body, Gr.,). The larvae of this species attaches a brown parchment-like cocoon to the leaves of its food plant. It was common among the alders round the Gomin Swamp.

The most destructive saw-fly thaat has troubled Canada in our day has been **Lygaeonematus Erichsonii** Hartig. Its armies showed themselves on our borders in 1872-3. In 1874 I witnessed a flight of them crossing the St. Lawrence. Wherever they went they carried devastation to the Tamarack forests. In the 22nd Annual Report of the Entomological Society of Ontario, page 28, will be found a carefully prepared estimate of the loss occasioned by them in one township alone. A very faint idea of the loss to the country at large may be gained from it.

The Dominion Entomologist, Dr. C. Gordon Hewitt, is now engaged in searching for parasites of this destructive pest. In a useful Bulletin (No. 10) lately issued much information concerning his work will be found.

Another "undesirable immigrant" to Canada was **Pteronus Ribesii** Scopoli. This made its appearance in 1858. It assails our gooseberry and currant bushes, commencing its operations as soon as the foliage appears and outdoing in damage the native currant saw fly, **Pristiphora grossulariae** Walsh.

The males of **P. ribesii** might easily be taken for a different species, for they are mainly black; whereas the females have honey-yellow abdomens.

The remedies against both Ribesii and Grossulariae are White Hellebore dusted over the bushes, or suds, made with whale-oil soap, sprinkled over them. In dealing with the pests promptitude is necessary for their defoliations proceed with rapidity.

Before they were killed by the Black Knot, the plum trees in the gardens at Levis were infested by the larvae of **Selandria cerasi** Peck. The widened anterior segments of these creatures, and their attenuated after parts, together with their dark colour and slimy appearance, were suggestive of tadpoles. Air-slacked lime sifted over the trees was the remedy recommended against them.

In the years 1897-8, the yellow black-spotted larvae of **Hylotoma pectoralis** Leach were very abundant upon birch around Quebec. When full fed they spun white, loose cocoons in their retreats. The perfect insects were heavy and sluggish, and numbers of them were trodden under foot by passers by. They were beautiful objects having black heads Indian-yellow bodies, and wings suffused with purple. I raised the parasite **Pimpla inquisitor** Say from this species.

In drawing up the following list of saw-flies, taken in the vicinity of Quebec City, and now in my collection of Hymenoptera at Ottawa, I have followed the classification and nomenclature of the late Dr. John Smith, Professor of Entomology at Rutgers College, U.S. and C.L. Marlatt, First Assistant Entomologist of the U. S. Department at Washington, D.C.

LIST OF QUEBEC-SAW-FLIES.

Lydidae

Bactroceros pallimacula Norton

Hylotomidae

Hylotoma clavicornis Fabricius.
Hylotoma pectoralis Leach
Hylotoma clavicornis Fabicius.

Selandriidae

Kaliosysphinga melanopoda Carn.
Monophadnus scelestus Cresson

Nematidae

Pontania hyalina Norton
Pteronus ribesii Scopoli.

Pteronus fylesii Marlatt.
Pteronus harringtoni Marlatt
Amauronematus luteotergum Norton.
Lygaeonematus erichsonii Hartig.

Tenthredinidae

Dolerus aprilis Norton.
Dolerus arvensus Say.
Strongylogaster politus Provancher.
Harpiphorus tarsatus Say.
Emphytus mellipes Say.
Macrophya epinota Say.
Macrophya intermedia Norton.
Macrophya tibiator Norton.
Macrophya mutens Norton.
Macrophya eurythmia Norton.
Tenthredo mellina Harris.
Tenthredo varipicta Norton.
Tenthredo xanthus Norton.
Allanthus basilaris Say.
Allanthus dubius Harris.

Cimbicidae.

Trichiosoma triangulum Kirby.
Zaroea Americana Cresson.
Cimbex Americana Leach.
Var. A. ulmi Peck.
Var B. 10—Maculata Leach.
Var. C. obscura Fyles.

THE POWDERY MILDEWS.

By. J. S. Dash, Macdonald College.

The powdery mildews belong to the family Erysiphaceae of the large class of fungi known as the Ascomycetes, being placed in the order Perisporiales of that group. They are often known as "mildews," "blights" or "white" mildews.

During the summer they are very evident on a large variety of plants, covering the leaves and often the stems and fruits with a white cobwebby mass of mycelium, on which large numbers of conidia or summer spores are produced. These give the host an appearance as though it were covered with a white powder.

The mildews are found practically all over the world, but are most abundant in north temperate regions, and their distribution is apparently not closely restricted by slight differences in climate. As a group, moisture is very essential for most vigorous development.

This family has long been subject to an undue multiplication of species, but Salmon, whose monograph is perhaps the most recent and most reliable work, includes in the family forty-nine species and eleven varieties.

The following genera are included in the Erysiphaceae:— Podosphaera, Sphaerotheca, Uncinula, Microsphaera, Erysiphe and Phyllactinia.

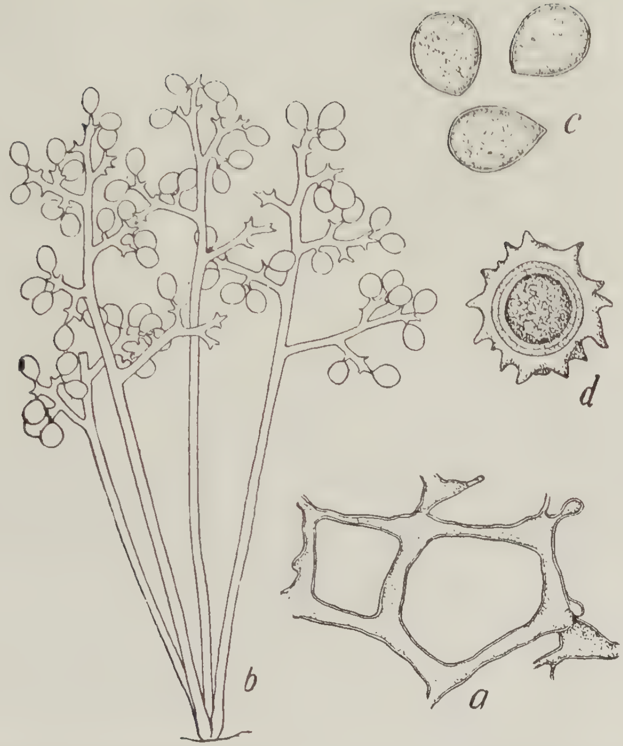
CHARACTERISTICS.

The characteristic feature of the Erysiphaceae is their true parasitism. Other characters are the abundant formation of conidia, capable of causing quick infection of the host, and the dehiscent perithecia, possessing outgrowths or appendages of a definite form and containing the non-septate ascospores.

HOST PLANTS.

According to Duggar, the various species and varieties have been reported upon about 1500 species of phanerogams. The plants that seem to be least affected are some belonging to the orders Liliaceae, Iridaceae and some other monocotyledons. Herbs, shrubs and trees are equally affected, and sometimes a single species may be found upon plants of all three sorts.

The mildews attack and injure many species of cultivated and native plants. As examples we cite the mildews affecting the grape, gooseberry, rose, cherry, plum, apple and various forest and ornamental trees. The leaves are usually the chief parts affected, thereby lowering the vitality of the plant; stems, twigs and fruit are frequently attacked, as in the case of the gooseberry mildew.



Downy Mildew of Grape (Plasmopara viticola). A. portion of the mycelium from a diseased grape; B. A tuft of spore stalks; C. mature spores; D. thick walled resting spore (from Longyear).

The morphology and life history of the different genera are very similar, and the family on the whole is such a coherent group that it may be treated as a whole in this regard. In fact it is practically impossible to distinguish between the conidial forms, insomuch that they were formerly classified as an autonomous genus of the Hyphomycetes under the name **Oidium.**

The vegetative mycelium consists of numerous branching, septate, white hyphae. These are always much interwoven. The septa do not occur at very close intervals, giving the hyphae the appearance of being divided into rather long cells.

In all the genera, except Phyllactinia, the hyphae form haustoria which penetrate the cuticle and make their way into the epidermal cells. The function of these, of course, is to attack the fungus and obtain nourishment. The genus Phyllactinia forms special hyphal branches which enter the stomates or breathing pores and then send out haustoria which penetrate the surrounding cells. In general it may be said that with the exception of the haustoria and the hyphal branches of Phyllactinia the mycelium of the Erysiphaceae is entirely superficial.

During the summer and early fall the asexual reproduction takes place by means of conidia. They are cylindrical or ovate colorless cells, filled with protoplasm, and borne on the ends of special branches,—the conidiophores—which are erect, colorless or white and possess one to several septa or cross walls. The conidia are formed from the conidiophores by constriction from the ends, and are frequently found in chains, where several from the end of the same hypha have fallen off together. During the growing season large numbers of conidia are produced. These are carried about very easily by the wind and germinate rapidly on the host plant by sending out a tube. Under proper conditions this soon develops into a new mycelium. Salmon says "Even in a dry atmosphere, but more rapidly in a damp one, or in water, one or more delicate germinal tubes are produced near one end of the conidium." By means of the conidia, then, the mildews are rapidly spread.

In autumn when the vitality of the plant is low, the perithecia or true fruiting bodies are produced. According to DeBary these represent a sexual stage. They are usually globose in shape and contain resting spores which carry the fungus over winter. The spores are colorless, granular and oval, and are borne in colorless, sessile or stalked sacs known as asci. The number of asci varies in the different genera. Salmon states that they may be from 1-66 and the number of ascospores may vary from 2-8. These ascospores require to pass a winter before they will germinate.

When the perithecia are about half-grown, appendages begin to grow out from the outer wall. These appendages vary in form and with the number of asci are the characters on which the genera are based. In the spring the wall of the perithecium opens by an irregular rupture and the asci are liberated.

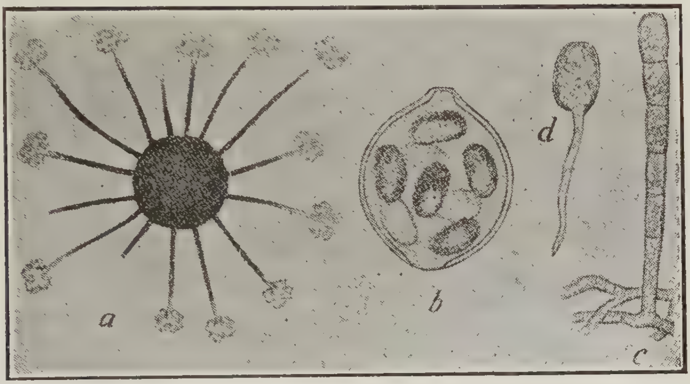
This family is parasitized to a great extent in Europe, but it is not common in America.

RELATIONSHIP TO HOST—SPECIALIZED FORMS OR RACES.

It has for a long time been an unsettled question in the minds of botanists whether the powdery mildews have the capacity for infecting host plants other than the one from which they came. In spite of the fact that some of the species are found on many host plants of different families, e. g. **E. polygoni, E. cichoracearum,** yet many of them are limited in their choice of host plants to certain families, e. g., **A. salicis** on **salicaceae, S. pannosa** on **rosaceae, E. graminis** on **gramineae.** Instances are also known where the hosts of the fungus are limited to one genus.

From the work that has been done by Reed and Salmon there would appear to be several specialized forms or races of **E. graminis.** This species is known to attack the family Gramineae, including barley, oats, rye and wheat. Experiments have been made which go to establish the fact that a distinct race of this mildew is now found on the species and varieties of each of the four genera of cereals,—Avena (oat), Hordeum (barley), Secale (rye), and Triticum (wheat). The mildews which attacks one of these genera will not pass on to a species belonging to any of the others. It has even been established that some species of a genus may be immune to the mildew which attacks other species of the same genus.

The genus Erysiphe has received more attention in this matter than any other, and while some experiments have been carried out with the others, the data is not very satisfactory.



Powdery Mildew of the Cherry (Podosphaera oxyacanthae). A. winter spore case, B. ascus. C. and D. the formation of summer spores.

FORMS OF ECONOMIC IMPORTANCE.

Although I have examined most of the common species in the laboratory it is not my intention here to go into a detailed description of them, but merely to mention, with notes on their control, a few of the more economic forms.

The following is a key to the genera:—

A. Perithecia with a single ascus.

1. Appendages simple, flexuous, and undivided at tip, **Sphaerotheca.**
2. Appendages once or more dichotomously divided at tip, **Podosphaera.**

B. Perithecia with several to many asci.

1. Appendages never more than slightly swollen at base.

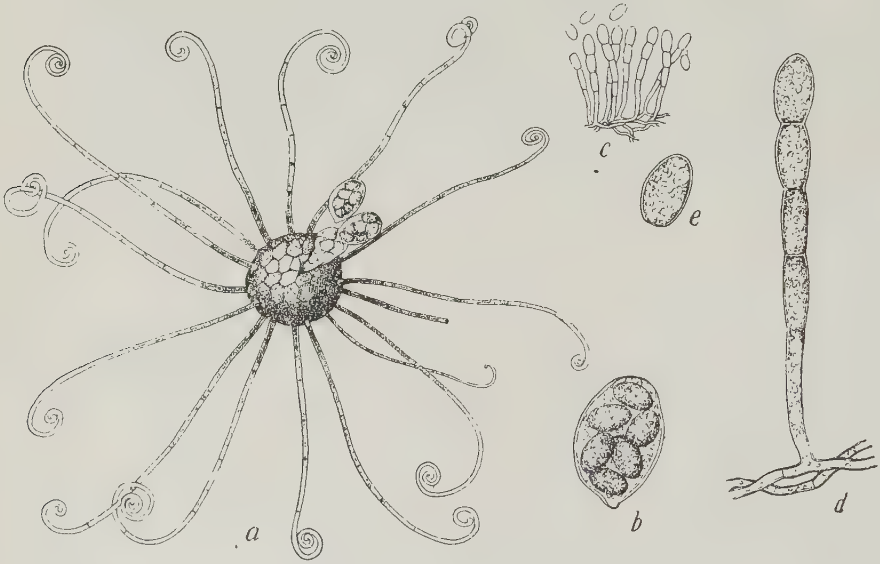
a Appendages simple or more or less flexuous, without tip peculiarities. **Erysiphe.**

b. Appendages usually straight, once or more dichotomously branched at tip, **Microsphaera.**

c. Appendages usually straight and spirally inrolled at tip, **Uncinula.**

2. Appendages swollen at base so as to form an enlarged plate, **Phyllactinia.**

THE GOOSEBERRY MILDEW **(Sphaerotheca mors-uvae).** This species has long been known in the United States. It attacks the leaves and stems, but especially the berries, where it forms dense patches of brown thick-walled mycelium. The fruit thus attacked is practically unfit for use. It is in this mycelium on the fruit that the perithecia are imbedded.



Powdery Mildew of Grape (Uncinula Spiralis). A. winter spore case ; B. ascus ; C. D. E. formation of summer spores. (After Longyear).

Control. It is a difficult one to control, but in the United States good results have been obtained by the use of a strong potassium sulphide spray in the proportion of 1 oz. to 2 gallons water. Spray about the time the leaves and buds are opening. Repeat every 10 to 12 days if necessary. Some workers recommend Bordeaux Mixture, 4-4-40 formula, spraying before the leaves open, after blossoming, and two weeks later. This may discolor the fruit, however. In Canada lime-sulphur has found favour with many. According to experiments carried out at the College, it would seem that lime-sulphur is better than either potassium sulphide or Bordeaux. Best results were obtained with commercial lime sulphur diluted 1: 20. This did not injure the foliage. Three sprayings were found advisable, the first early in April, the second early in May, and the third early in June. Where a hydrometer is obtainable a safe practice is to spray shortly before the buds burst with the fungicide of 1.030 sp. gr. A second spraying should be given just before the blossoms appear with the fungicide of 1.009 sp.gr., and a third spraying of the same strength just after the fruit is formed.

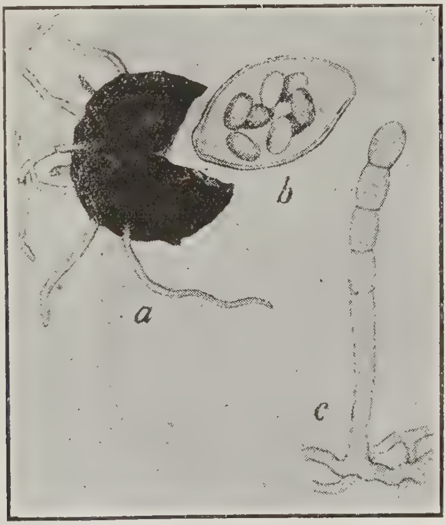
ROSE MILDEW **(Sphaerotheca pannosa).** This is very troublesome on roses grown in the greenhouse or in shady situations. The fungus causes the leaves to curl and so their function is interfered with.

Control. Thoroughly dust with powdered sulphur every ten days, or as often as necessary. Lime sulphur is recommended by some, also Ammoniacal Copper Carbonate.

APPLE AND CHERRY MILDEW **(Podosphaera oxyacanthae).** This is found on a large number of rosaceous and other plants, apples, plums, thorn apples and cherries being the most common ones attacked.

It is placed among the destructive diseases because it frequently does harm to apple nursery stock and to cherry.

Bordeaux mixture 4-4-40 will keep it in check.



Powdery Mildew of Gooseberry (Sphaerotheca mors-uvae) A. resting spore case discharging its single spore sac (ascus) B. which contains 8 winter spores.

POWDERY MILDEW OF GRAPE **(Uncinula necator).** This mildew is found principally on the leaves of the grape, and in moist situations may do considerable injury. It develops on both sides of the leaf and spreads very rapidly owing to the large number of conidia produced.

Control. The most successful method of control seems to be the dusting of the leaves with powdered sulphur. The use of self boiled lime-sulphur has also been recommended.

Of the other common forms, we should like to mention: —

Powdery Mildew of willow and poplar,	**Uncinula salicis.**
Mildew of woody plants, lilac and others,	**Microsphaera alni.**
Powdery Mildew of peas,	**Erysiphe polygoni.**
Mildew of Composites,	**Erysiphe cichoracearum.**
Common Mildew of trees,	**Phyllactinia corylea.**

These forms do not often become injurious enough to be considered of very great economic importance in Quebec.

THE ROLE PLAYED BY BEES IN FERTILIZATION OF FLOWERS.

By. F.W.L. SLADEN, Assistant Entomologist of the Department of Agriculture, Ottawa.

The flower contains the reproductive organs of the plant, the organs are sexual and it is necessary for the male element, the pollen grains—to come in contact with the female element—the ovules—in order that the latter may produce seed. The pollen grains are shed by anthers which are borne on slender threads called stamens.

A rod called the pistil arises from the ovary, or vessel containing the ovules, on the end of this is a protuberance, called a stigma, the surface of which is sticky so that the pollen grains adhere to it.

Here they germinate and send processes down the pistil which enter the ovules and so fertilization takes place.

The two chief agencies employed by plants to bring the pollen grains to the stigma are wind and insects.

It should be noted that in some plants the sexes are in separate flowers, but the majority of flowers are hermaphrodites e.g. male and female organs are in the one flower. These flowers would seem to be easily self-pollinated, but as a matter of fact they depend mostly on insects for fertilization, for, not only is the pollen somewhat glutinous but in many instances self-pollination is impossible.

There are all kinds of special arrangements to prevent it, either the anthers mature and shed their pollen before the stigma is receptive, as in the cases of the willow herb (Epilobium augustifolium) the garden sage (Salvia officinalis)! and the nasturtium (Tropœolum majus) or that the stigma withers before the flowers are pollinated or before the anthers burst, as in the case of the fig-wort.

In some apparently hermaphrodite flowers, the anthers or the ovaries are sterile, therefore they are uni-sexual.

Some flowers, it is true, are absolutely self-fertile, the sweet-pea (Lathyrus odoratus) for example, but there are many others that may be able to pollinate themselves, yet they produce more abundant and better seed when pollinated by another flower. The structure of flowers enables insects to pollinate them. Nectar and pollen are offered in return for fertilization, and the insect is shown the way to them by means of colors that contrast well with green, such as red, blues, purples, yellows, the whites, not brown, which stand out on our railway signals, sign-boards, etc. It is the petal of the flower that is usually colored. To be effective signs, and seen at a distance, the flowers must be of good size or massed together as is clover.

A few flowers such as figwort have their nectaries more or less exposed and the honey can then be collected by short tongued insects as flies or wasps, but most flowers store it in pits or tubes, only accessible to long tongued insects such as higher bees and the industrious honey bee which is far the most important fertilizer of plants and useful fruits. Some plants indeed, such as the red clover and nasturtium have the honey at such a great distance down a narrow tube that only the extra long-tongued bees, namely the bumble bees can reach it.

The honey bees, the bumble bees and more solitary bees live through the winter in the adult stage, and so are ready to work when the fruit trees are in bloom and other insects are scarce. Their hairy bodies and tongues are specially adapted to transferring pollen and they are particularly effective as pollinators on account of the busy and methodical way they work from blossom to blossom and from plant to plant.

Darwin found that 20 heads of common white clover (Trifolium repens), covered with a net so that bees could not visit them, yielded only one aborted seed, while 20 uncovered heads that were seen visited by bees yielded 2290 seeds. An unprotected head of sweet clover (Melilotus officinalis) produced at least 30 times more seed than a protected one.

It is well known that the production of many kinds of fruit depends largely on the pollination of the blossoms by bees.

Hooper, a recent and careful investigator in England, has found that honey bees and bumble bees are absolutely necessary for the production of gooseberries and currants. They are also necessary for pears, apples, cherries and plums, many varieties of which will not set fruit from the same tree or variety. It is therefore advisable in planting to intermix two or three varieties blooming at about the same time.

Care should be taken in the choosing of the varieties planted together, as the pollen in a certain variety often produces better results than that of another variety. In long-continued fine weather bees will pollinate blossoms at a distance of two or three miles from the hives, but in less favorable and broken weather they do not go far afield when the flowers may be waiting for their services. A great excess of bees is therefore desirable and they should be kept near the orchard. The apple blossom has five stigmas each of which must be separately dusted with pollen for the production of a perfect apple. There is reason to believe that in some parts of Canada bumble bees are less plentiful than they were. They too should be encouraged as they work in less favorable weather than honey bees. If one apple blossom out of six sets, that would give a sufficient crop in most cases.

Raspberries and loganberries also need insects to pollinate them, and here again honey bees and bumble bees are by far the most important visitors. Hooper thinks, from observations made in 1911-1912 in Kent and Devonshire, England, that when honey bees are in the district roughly about 80 per cent of the pollination is done by them, 15 per cent done by bumble bees and 5 per cent due to solitary bees, ants, beetles and flies. These figures are probably not far wrong for Canada.

The strawberry is pollinated by wind and can set fruit well almost without insects.

SOME INSECTS WHICH ATTACK THE ROOTS OF VEGETABLES.

By Arthur Gibson, Chief-Assistant Entomologist, Experimental Farm, Ottawa.

The roots of vegetables are liable to attack by the larvae of certain insects, some of which when excessively abundant destroy whole fields of crops. The more important of these are the following:

ROOT MAGGOTS.

These maggots which attack the roots of such vegetables as cabbages, cauliflowers, turnips, radishes, beans and the bulbs of onions are similar in appearance, being whitish in color and about one quarter of an inch in length. The species which attacks cabbages, cauliflowers, radishes and turnips is called the Cabbage Maggot **(Pegomya brassicae)**, and that which destroys the bulbs of onions is the Onion Maggot **Pegomya ceparum.)** There is a third species which works in beans and corn, namely the Seed-corn Maggot **(Pegomya fusciceps.)** The adult flies of all these species are rather smaller than the common housefly. In spring when cabbages and cauliflowers are set out or when radishes, onions and beans appear above the ground, the adult flies deposit small, white, elongated eggs on the stems of the plants. These hatch in a few days and the young maggots burrow down and feed upon the roots. There are several broods in a season and injury may continue from May until Autumn. The chief injury is done in May and during June.

REMEDIES. For cabbages and cauliflowers the tarred paper disks made from tarred building paper, cut into hexagonal form and placed around the stems at the time of planting will protect the plants against the ravages of these maggots. The disks are quickly cut out by means of a tool made as shown in the accompanying figure. The blades of the tool can be made by any expert blacksmith from a band of steel bent in the form of a hexagon. The part making the star shaped cross is made from a separate piece of steel. When the cabbages or cauliflowers are planted out the disk must be placed around the stems as soon as possible. Care must be taken in this regard so that the disks will fit closely and lie flat upon the ground, otherwise protection will not be complete. The object of these disks, of course, is to prevent the flies from laying their eggs upon the stems. For radishes, onions and garden turnips a carbolic mixture consisting of one pound of hard soap dissolved by boiling, in a gallon of water and afterwards adding one pint of crude carbolic acid and the whole boiled for five minutes, is useful. Such a formula will make a stock solution one part of which should be used to fifty parts of water. Fresh pyrethrum insect powder, or white hellebore, two ounces to one gallon of water, are also of value. All of these mixtures can be applied in small gardens by means of a watering can, or in larger areas may be sprayed directly upon the plants by means of a spraying pump. The first application should be made just as soon as the plants appear above the ground, and further treatment should should be given once a week for several weeks, or until the plants are strong enough to resist attack. In the case of radishes the treatment should be continued until the roots are almost ready for the table.

WHITE GRUBS AND WIREWORMS

White grubs and wireworms which are the larvae of the June beetles and the Click beetles respectively are often troublesome in gardens, particularly to the tubers of potatoes. Unfortunately these insects are difficult to control. Ploughing infested land in late autumn will disturb many of the insects when in an immature stage and expose them to frost and other destructive agencies. In spring when the ground is again ploughed or dug up, all grubs seen should be picked up and destroyed. If at this time pigs are turned into the infested gardens they will find these insects and devour them.

THE CARROT RUST FLY

In many parts of Eastern Canada, in some seasons, considerable injury is done by this insect, which was introduced from Europe many years ago. The adult two-winged fly is about a quarter of an inch long, of a bright, shiny, greenish-black color, with yellow legs and red eyes. Early in the season the female deposits her eggs on or near the roots and the little yellowish maggots soon hatch and attack the roots, which they eventually tunnel in every direction. When the leaves of carrots begin to turn reddish, the roots will most likly be found to be infested by these maggots. Two broods at least occur during the season. When carrots are finally harvested and stored for winter use they are often found to contain brownish burrows where the maggots have been working.

REMEDIES. When young carrots are being thinned out, the spraying of the remaining plants with ordinary kerosene emulsion, one part in nine of water, has been found of value as a protection against injury by this insect. Applications should be made every week during June and July. Sand impregnated with coal oil has also been found useful and may be scattered along the rows every week. About half a pint of coal oil is sufficient for an ordinary pailful of sand. The odor of coal oil is disliked by the flies and the object, therefore, is to make the plants objectionable so that they will not visit them for the purpose of depositing their eggs. In our experiments we have found that carrots sown as late as the third week in June were of good size and quality in addition of course to being free from injury by the Carrot Rust fly.

SOME INSECT ENEMIES OF SHADE-TREES.

By J. M. SWAINE, Ottawa.

Shade trees and ornamental trees in city parks or streets, or private grounds are subject each season to more or less injury from attacks of insect foes. At times the trunks or the larger branches are infested with boring grubs or caterpillars, or the inner bark may be destroyed by the adults and larvae of the bark-beetles, or the foliage more or less serious-

Tunnels in wood made by borers.

ly eaten by caterpillars, grubs or saw-fly larvae. Some of these enemies kill the trees or their parts, or seriously injure them, while others disfigure the branches by their feeding, or by unsightly webs, and rob the foliage of much of its beauty without threatening the life of the trees.

The majority of our ornamental trees are native and are subject to attack from the insects of our forests, and many of the trees and shrubs which have been introduced from other countries prove quite acceptable to our native insect pests. At different times and in various ways certain destructive forest insects have been introduced from Europe or elsewhere to add to our already long list of pests, and others may appear at any time. These introduced species are sometimes more destructive with us than they appear to be in their native country, owing chiefly to their freedom here from natural parasites.

Tunnels in wood produced by borers.

In Eastern Canada we are yet free from certain destructive shade.tree insects which have caused much loss in the United States south of us. Sooner or later some of these may be introduced into this Province, and unless promptly recognized and controlled may become firmly established.

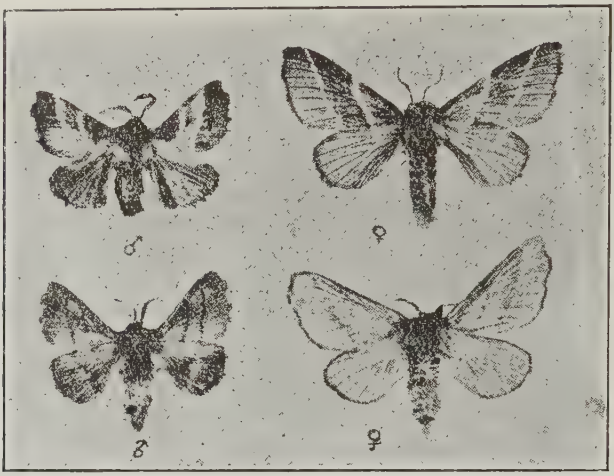
Chief among these are the Brown-tail Moth and the Gypsy Moth. The latter is not yet known to be breeding in any part of Canada. The Brown-tail moth has become at least temporarily established in New Brunswick and Nova Scotia; but it has not yet become a pest; and it is hoped that the energetic measures employed for its eradication may prove effective. The conspicuous silken winter nests, containing living caterpillars throughout the winter, cannot be confused with the work of any of our native insects.

The Elm Leaf-beetle (Galerucella luteola Mull) is a most destructive enemy of Elms throughout the Eastern States. The adult is a small dark-yellow beetle with dark stripes along the back. The adults and grubs feed upon the leaves and, when numerous, defoliate the trees. Great numbers of elms have been killed by this insect throughout its range.

Recently the elms about Boston have been attacked by the Elm Bark-beetle (Eccoptogaster multistriata Marsh) a species imported from Europe probably about ten years ago. It breeds between the bark and the wood, and attacks chiefly weakened and unthrifty trees. A discovery of these small black beetles, one eignt of an inch in length, with their whitish grubs, beneath the bark of dying elms, should receive immediate attention. The adult beetles bore through the bark and cut egg-tunnels along the surface of the wood. From the eggs laid along the sides of these egg-tunnels, the larvae or grubs hatch and mine outwards through the inner bark. After pupating in the ends of these larvae-mines and transforming to adults they cut round holes through the bark to freedom.

A Cluster of Forest Caterpillars.

The Hickory Bark-beetle, (Eccoptogaster spinosus), a much larger species of the same genus, is destructive to hickory trees as far north as Lake Erie. So far we have no evidence of any injury in Canada, although I have seen specimens taken in Southern Ontario. It is similar in habit to E. multistriatus.



Moths of the Tent Caterpillar—Orchard above and Forest below.

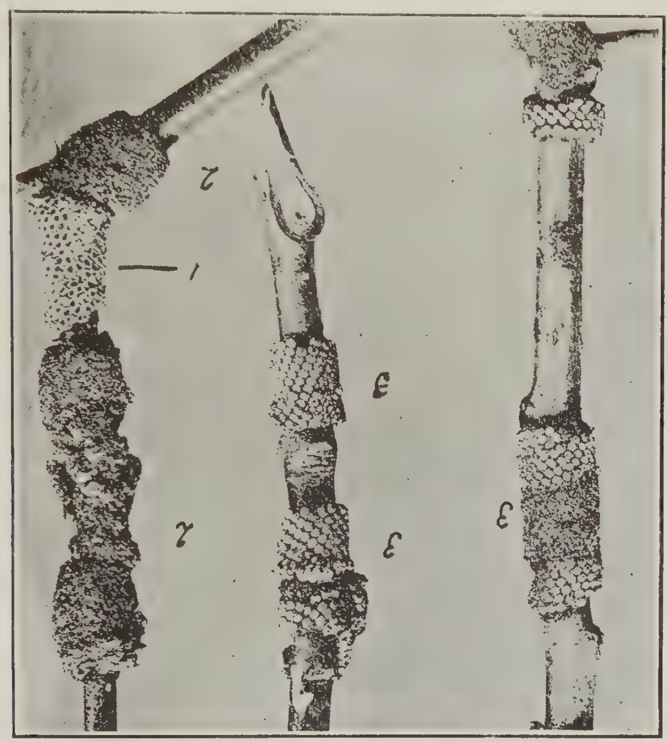
The Leopard Moth (Zeuzera pyrina Linné) is another importation from Europe, destructive to deciduous shade-trees. Its large caterpillar bores in the wood and has become a very serious shade-tree pest throughout the region between New York and Boston.

We should be on guard against importations of such destructive insects; members of this Society may have the opportunity to perform useful service in reporting or directing the control of some of the enemies just mentioned.

We have, of course, quite sufficient troubles of this sort already, and of these a few are briefly discussed here.

The **Forest Tent-Caterpillar.** This tentless Tent-Caterpillar was extremely abundant in many parts of Quebec Province last season, 1912. With it were many of its near relative the American, or Apple-tree Tent-caterpillar. The moths of both species were extremely abundant and have deposited myriads of egg-masses, which will give forth young caterpillars in the coming spring (1913). The moths were attracted to the lights of cities and towns, so that the shade trees of the streets and parks in many places have their twigs simply plastered with the egg-masses. Judging from our results in forcing several hundreds of these in the laboratory there are few egg parasites, at least about Ottawa; and unless the weather conditions of the early spring are extremely unfavourable to insect life, the season of 1913 is likely to be remembered in many parts of Quebec Province as "the Caterpillar Year."

The eggs of these insects are laid in ring-like masses about the twigs in July. There they remain until the following spring hatches the caterpillars coiled within them. The caterpillars then proceed to feed upon the young leaves, and when numerous completely strip the trees. At several places in Quebec, square miles of poplar and birch were completely defoliated last summer by the forest caterpillars; and on the Gatineau branch of the Canadian Pacific Railway in Quebec the trains were repeatedly stopped by the masses of caterpillars crowding upon the rails which were effectively greased by their crushed bodies.

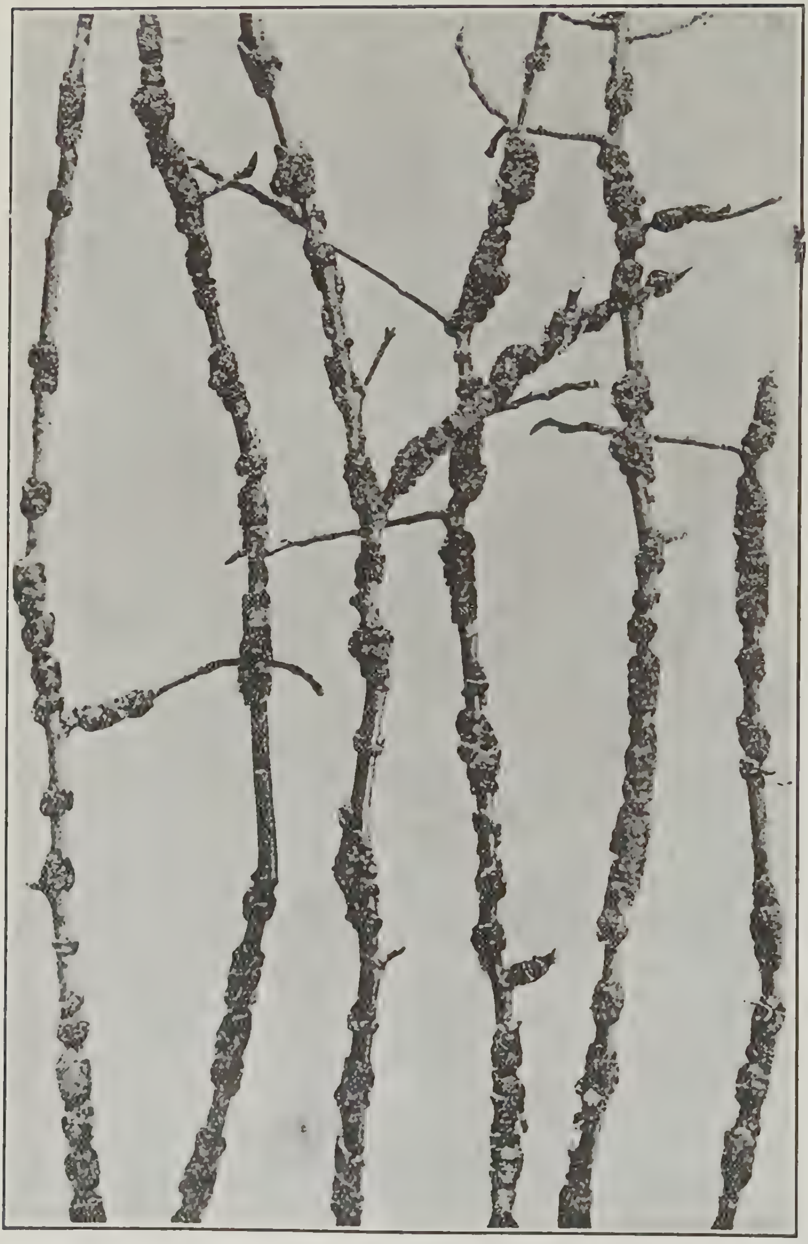


Egg Masses of Tent Caterpillars on Maple Trees. 1. Old egg mass. 2. Normal egg mass.

NATURE'S METHODS OF CONTROL.

Outbreaks of these caterpillars occur at intervals; during the intervening years, owing chiefly to the activity of their natural enemies, they are much less numerous or at times are even almost rare.

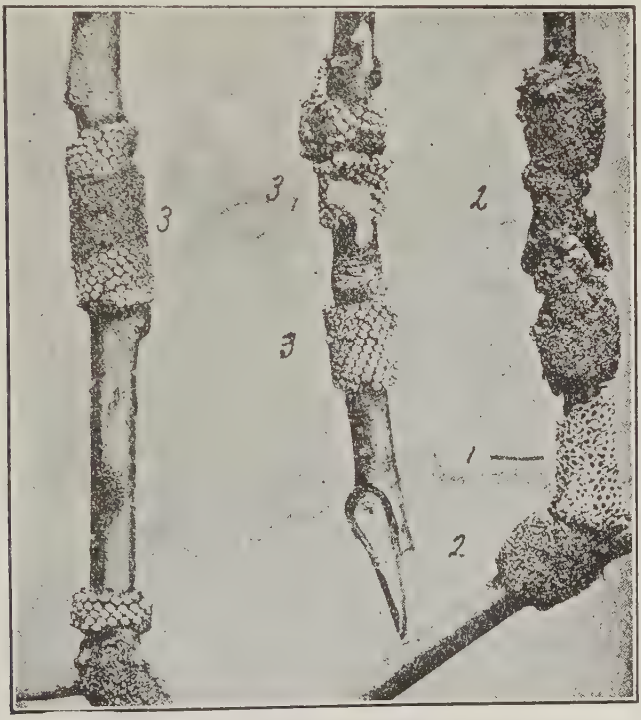
Insect Parasites. — Certain minute four winged insects of the Order Hymenoptera lay their eggs within those of the moths, and the resulting minute larvae, small white grubs, develop within the Tent Caterpillar eggs and destroy them. Certain other parasites of the Orders Hymenoptera and Diptera breed within the Tent Caterpillars and their pupae, and are most active agents in their control.



Twigs of Shade Trees clustered with the egg-masses of the Tent Caterpillar.

Several species of predaceous beetles and bugs are known to feed upon the caterpillars; and mites have been found destroying the egg-masses.

Birds. Many species of birds feed to a greater or lesser extent upon the eggs and caterpillars, and undoubtedly assist considerably in reducing their numbers. The following have been recorded by various writers as feeding on the caterpillars: Black and yellow billed cuckoos, Baltimore oriole, blue jay, crow, robin, catbird, American redstart, white-breasted nuthatch, wood thrush, chewink, black and white creeper, different vireos, flicker, scarlet tanager, yellow-billed sapsucker, bronzed grackle, chipping sparrow, towhee, English sparrow, chickadee, and cedar waxwing. Certain of these also feed upon the eggs, and others to a small degree upon the moths. The protection and encouragement of our native birds would go far towards reducing the numbers of many injurious insects of orchards, shade trees and forests.

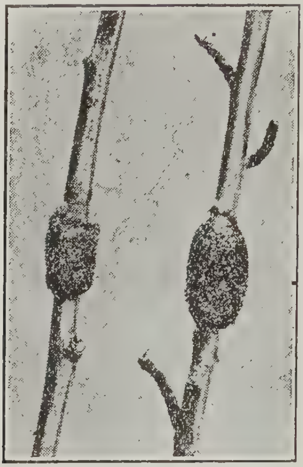


Egg Masses of Tent Caterpillars on Maple Trees. 1. Old egg mass. 2. Normal egg masses. 3.

Diseases.—A bacterial disease at times destroys many of the caterpillars and effectively aids in their control. Those affected by this disease often remain attached to the bark by a portion of the body. The internal organs are largely reduced to a dark-coloured fluid, which exudes when the skin is broken.

A second disease, fungous in its nature, is sometimes prevalent. The affected caterpillars become dry and rigid, and remain for some time with a portion of the body attached to the bark or twigs.

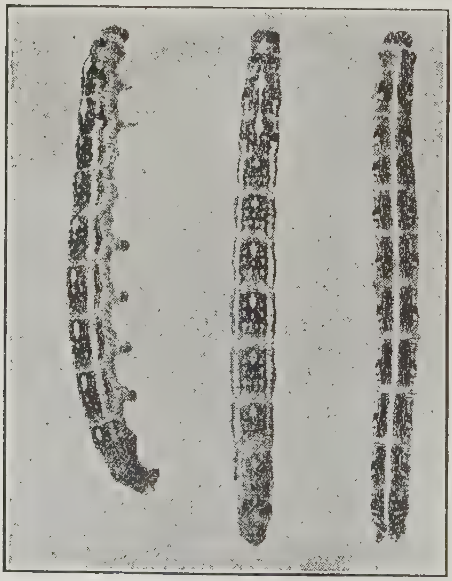
Both these diseases were noticed during 1912 in the Gatineau Valley, Quebec, but relatively few caterpillars were affected.



Egg Masses of Orchard and Forest Tent Caterpillar.

ARTIFICIAL METHODS OF CONTROL.

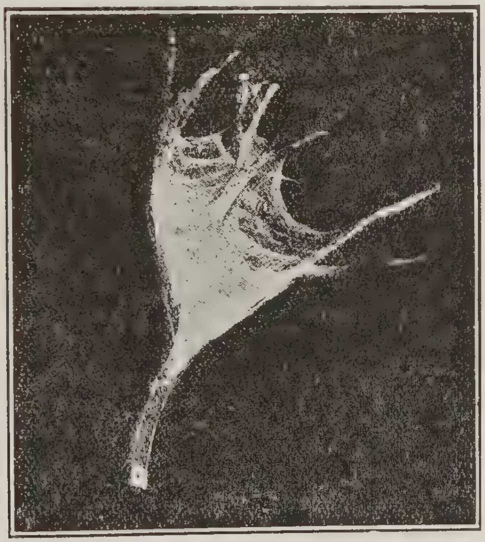
The control of these insects on wide areas of forest lands is not at present to be considered. The following directions apply to the protection of shade trees, orchards, parks and wood lots.



The Apple Tree and the Forest Tent-Caterpillars.

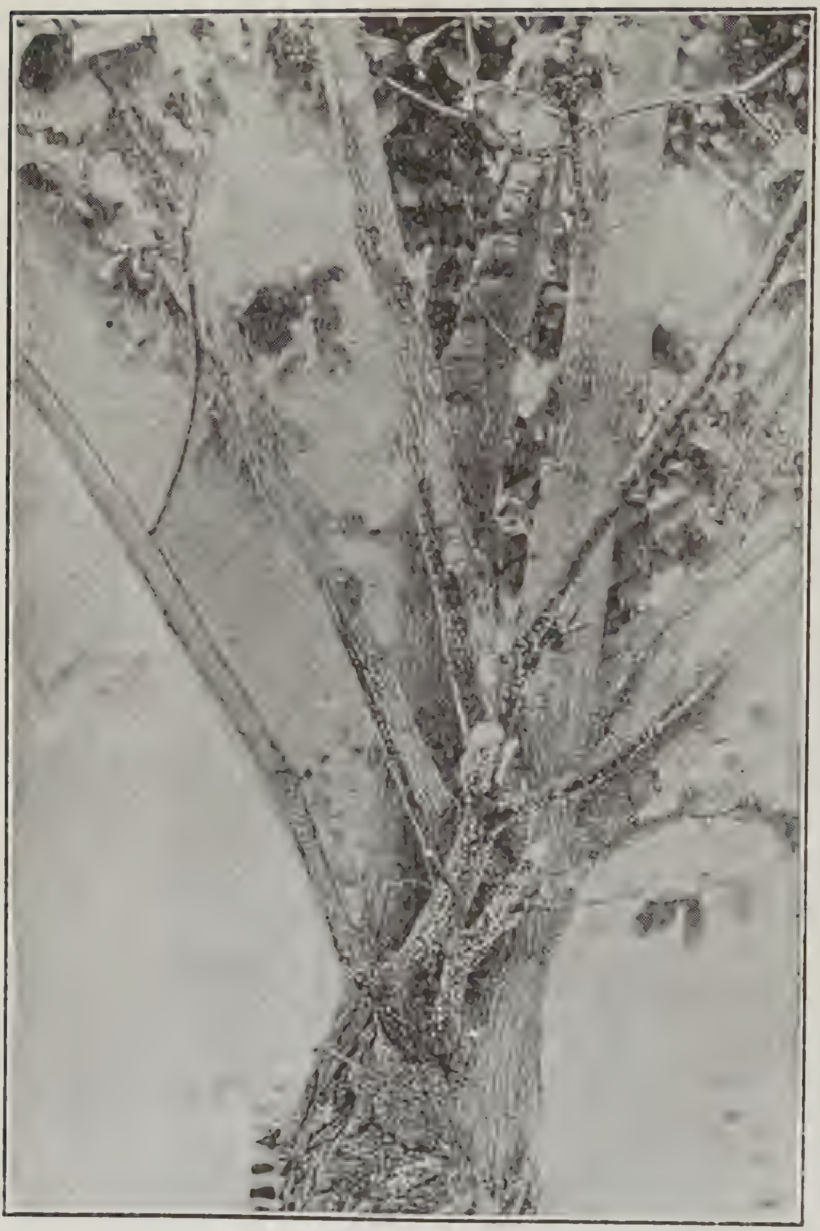
The Destruction of Egg-masses.—While the trees are bare of leaves the egg-masses may be very easily distinguished on the twigs From each egg-mass, approximately 150 voracious young caterpillars will emerge in the following April. Much good can, therefore, be done by removing these egg-masses from small and medium sized trees, and burning them before the first of April. This practice is profitable only on the more valuable fruit and shade trees, and needs to be supplemented by poison sprays in the spring.

Jarring.—The forest Tent Caterpillar usually drops to the ground when the parts of the tree near it are jarred or shaken. By striking the branches near the clusters of caterpillars with a. long-handled, padded mallet, the greater part of the caterpillars can be removed from small trees and from those of medium size. The trunks must then be banded with one of the adhesive mixtures described in the next paragraph, to prevent the creatures ascending to their old feeding grounds. It has been recommended to spread a large sheet beneath the trees before jarring, and to gather and destroy the caterpillars which fall.



Small tent of Orchard Tent-Caterpillar.

Banding.—Uninfested trees frequently need to be protected from wandering caterpillars which have fallen from their original food-trees or have been "jarred" therefrom, or are seeking new feeding grounds. These caterpillars can be prevented from climbing trees by banding the trunks, five or six feet up, with cotton or tree tanglefoot. A band of cotton batting, eight inches wide, fastened about the trunk with a string at the middle of the band, with the upper part of the cotton turned down over the string, has been recommended as an effective obstacle to the passage of the caterpillars. It is effective only when the cotton is dry.



The Elm Bark-Louse.

The most convenient band is made of some sticky substance such as tree tanglefoot or tar. Strips of thick wrapping paper, a foot or more in width, are tied about the trunk, five or six feet above the ground, with two strings and well smeared with "tree tanglefoot," tar mixed with two parts of raw oil, or a mixture made by boiling together equal parts of resin and castor oil. Axle grease, lard and sulphur, cottolene, and "raupenleim" are also used. The sticky substance must be renewed or extended as it dries or becomes covered with the caterpillars.

Destroying Tents and Clusters of Caterpillars.—The nests of the American Tent Caterpillar may be removed while small, and the contained caterpillars destroyed. This may be done with the aid of long handled tree-trimmers or with a brush, or the nests may be burned with a torch while the caterpillars are within them. The torch may be made of a mass of rags or cotton waste soaked in kerosene (coal oil) and tied on a long pole. Asbestos fibre soaked in kerosene and placed in a tin can nailed to the end of a pole makes an excellent torch. The flame should be passed below the nest so as to destroy it and the contained caterpillars, care being taken not to injure the bark of the branches, a rather difficult operation. The nests should, of course, be destroyed while the caterpillars are within them. The clusters of the Forest Tent Caterpillar may be removed when they are massed on the lower branches or trunks of the trees by means of a torch or by brushing them off with a stiff wire brush, or they may be killed by a strong spray of kerosene emulsion applied directly to the caterpillars.

Gathering Cocoons.—After the caterpillar stage is past and the cocoons are spun the latter may be gathered and thus the escape of the moths which emerge will be prevented. The collected cocoons should be placed in a box covered with a coarse wire netting, about three sixteenths of an inch mesh. This will allow the useful parasites to escape, but retain the moths which may be destroyed later.

Spraying.—When spraying apparatus is available the simplest and most convenient method is the application of Paris green in the proportion of one pound to 160 gallons ofwater, or lead arsenate, two pounds to 40 gallons of water, to the infested trees or parts of trees, after the leaves have appeared. Orchards which receive the regular poison sprays for the codling moth and the plum curculio rarely suffer from Tent caterpillars. The young caterpillars are killed by the poison before they are able to do much damage. After they are more than half-grown it is much more difficult to kill them by arsenical preparations; and they should, therefore, always be attended to early in the season. When it is necessary to spray specially for these pests, it is usually sufficient to apply the mixture to the foliage on the particular branches which are attacked. Lead arsenate is perhaps to be preferred on account of its adhering qualities. These poisons kill only when swallowed by the caterpillar; it is therefore useless to spray before the buds open.

FORMULAE FOR SPRAY MIXTURES.

Paris Green.—Paris green, 1 lb.
Best grade quick-lime, 2 lbs. (Prevents burning).
Water, 160 gallons.

Preparation.—The Paris green is made into a paste with a little water. The quick-lime is slacked with sufficient water and strained free

from hard lumps. The Paris green paste and the slacked lime are then stirred into the required amount of water. The Paris green particles are heavier than water and the spray mixture must be constantly stirred while spraying is in process. When the caterpillars are over one-third grown 120 gallons of water should be used.

Tree-tanglefoot is a commercial preparation and may be obtained through dealers in insecticides. LEAD ARSENATE.—This insecticide may be obtained in quantity in the form of paste. This must be worked up in a small amount of water before being diluted. It is used on fruit trees and shade trees at the rate of two pounds mixed in forty gallons of water. This strength will readily control young Tent-Caterpillars, but the older ones, one third grown and over, need a stronger spray, four pounds per barrel (40 gals. of water). Lime is not needed with this insecticide.

When the hatching caterpillars are extremely numerous the stronger sprays may be used with advantage.

In orchard practice these poisons are added to the fungicide used at the rate given above. Paris green may be added to Bordeaux mixture; lead arsenate to either Bordeaux or lime-sulphur wash.

It must be remembered that both Paris green and lead arsenate are violent poisons.

Shade trees may be most easily protected by spraying the infested branches with lead arsenate as soon as the caterpillars appear, and promply banding the trees with "tree-tanglefoot' or a similar preparation as previously suggested, to prevent reinfestation. When spraying apparatus cannot be obtained, other means, recommended above, may be employed to remove the caterpillars from the trees.

THE DESTRUCTION OF USELESS TREES.

It too often happens that useless and neglected apple, wild cherry, and hawthorn trees are allowed to live in the neighbourhood of apple orchards. On these the Tent Caterpillars, other leaf-feeding caterpillars, certain boring-beetles and fruit pests breed undisturbed, and readily spread to near-by orchards. Particular attention should be paid by orchardists to the removal of these useless and dangerous trees, and, as already suggested, to the protection of our native birds.

The **Birch leaf Skeletonizer,** (Bucculatrix canadensisella). These small green caterpillars skeletonize the leaves of birches. The caterpillars spin small round white moulting cocoons on the twigs and leaves, and later spin yellowish, ribbed, elongate cocoons within which they pupate. Infestations by this species rarely last more than two years; for by that time its natural parasites usually obtain control of it. The caterpillars may be killed by spraying infested trees with Paris green or lead arsenate.

The **Elm Bark Louse** (Gossyparia spuria Modeer). The females of this species are dark red, bordered with white wax and one-tenth of an inch in length. They are usually arranged along cracks or fissures in the bark of trunks and limbs, and lie irregularly on the twigs. They suck the sap from the inner bark, and the leaves below infested limbs become coated with honey-dew and wax. The young appear in late June or early July and are most readily controlled at that time.

Imported elms have been killed by this insect near Ottawa in the last few years. It may be controlled by spraying with kerosene emulsion or fish-oil soap when the young are crawling upon the bark, or by using a stronger mixture early in the season before the buds have opened.

The **Locust Borer** (Cyllene robineae Forst) has been quite destructive in Southern Ontario to Acacias. The powerful grubs drive their tunnels throughout the trunk and kill the trees. I have no record of this species actually from Quebec, but it may be expected wherever Acacias and locusts are grown.

The control of this species is particularly difficult. The infested trees should be felled during the winter and burned before spring.

Bark-beetles and Long-horned beetles are at times destructive to ornamental conifers. When Pines, Spruces or Firs are seriously attacked by either of these classes of borers the trees are past all hope of recovery and should be cut and burned to destroy the contained beetles. These beetles rarely attack healthy shade-trees in Canadian cities. Usually the tree is very seriously weakened before the Bark-beetles or Horned-beetles enter it. Every effort should be made to keep the tree in a thrifty condition.

The **Bronze Birch Borer** (Agrilus anxius). This small elongate dark-colored beetle and its very elongate whitish grubs are the most serious enemies of our ornamental white birches. Imported varieties suffer more seriously than native species. The grubs construct very long winding tunnels in the sap-wood of trunks and large and small branches. Evidence of their work appears in the rusty patches on the bark of trunk and limbs, and the dying tops and branches.

Sooner or later the branches become girdled and the tree weakened by the numerous interlacing tunnels cut through the sap-wood. The tree begins to die usually at the top, but the removal of the top is then of little use, for the grubs are by that time working in many parts of the tree.

The only method of controlling this very destructive species is to cut out and burn all infested trees as soon as the injury becomes apparent. This reduces the number of the pests and prolongs the life-time of the remaining birches.

The **Poplar Borer** (Saperda calcarata Sat) is responsible for the death of many ornamental poplars. It is very destructive throughout this Province and elsewhere to all varieties of poplar.

The adults emerge from the wood during the summer, and the young larvae may be found working in the bark during the Autumn. The larvae or grubs live within the wood for probably three years, and drive their tunnels through the trunk in all directions. The writer has taken them from the heart-wood of the largest poplars. Rough, discoloured scars and swollen areas on the trunk and branches of poplars are frequently caused by this insect, and dying branches and portions of the trunk are a common result of its work.

Infested trees of little value should be removed and burned before June. Valuable trees may be protected in large measure by searching for the young borers in bark, during the fall, and destroying them. The older grubs may sometimes be killed by injecting benzine or carbon bisulphide into the borings.

The **Fall Webworm** (Hyphantria cunea). This species is sometimes confused with the American Tent Caterpillar. The tents of the web-worm are constructed largely during the latter half of the season, whereas the tent-caterpillar ceases to work early in July. The tents of the web-worm are rougher, more irregular, and extend over the feeding grounds of the caterpillars, so that in time entire branches are covered. The hairy caterpillars are often heavily parasitized, otherwise their control would be more frequently necessary.

The **White-marked Tussock Moth** (Notolophus leucostigma). The shade-trees of Montreal and a few of the smaller towns are often badly infested by this beautiful caterpillarwith the tufts of black and yellowish hairs. Every few years this species becomes so numerous that many deciduous trees are badly stripped by it, and the thousands of crawling caterpillars become a positive nuisance. There is fortunately but one brood and the trees have an opportunity to recover somewhat during the latter part of the season. The pest is readily controlled by poison sprays and its native parasites are very effective in holding it in check.

The **Spruce Bud-worm** (Tortrix fumiferana) has been an important forest enemy in large areas in Quebec for some years, and has been frequently reported injuring ornamental spruces. The small caterpillars feed upon the opening buds, and later upon the needles, which they tie together with silk. The injury to many buds checks the season's growth and the dying, partly-eaten leaves with the excrement and silk spun irregularly by the larvae give the trees a scorched appearance and detract largely from their beauty. They may be controlled by spraying with Paris green or lead arsenate.

The **Larch Saw-fly** (Nematus Erichsonii) is sometimes quite destructive to native and European larches. The caterpillar-like larvae feed upon the needles, and if numerous enough, entirely strip the trees of their foliage. Those who own valuable ornamental larches should watch for this enemy, and spray the foliage thoroughly with Paris green or lead arsenate as soon as the larvae appear, and before the foliage is much injured.

Other leaf-feeding species, such as the Spruce Saw-fly, which quite frequently strips the foliage from ornamental spruces; the Hickory Tiger-moth, common on many deciduous shade trees, and many others, are controlled by poison sprays.

The **Spruce Gall Aphides** (Chermes similis and C. abietis). These two species of plant lice feed in the axils of the young needles, sucking the juices. The irritation causes an abnormal growth of the bases of the needles so that eventually a more or less cone-like gall is produced. The affected twigs are frequently killed, and many fine ornamental spruces in different parts of Quebec Province have been badly disfigured or destroyed in recent years by these two species.

Thorough spraying of the infested trees with whale.oil soap, one pound to two or three gallons, in early spring while the trees are dormant, is recommended.

THE FUNCTION OF TOADSTOOLS IN NATURE.

By. W.A. McCubbin, M.A. Ottawa.

In the middle ages, when there was not the help to minute and extended observation enjoyed by the present period of microscopes, toadstools, mushrooms and all their kind which we now designate collectively fungi bore a very doubtful and even sinister reputation. No doubt the poisonous properties of several of them had a great deal to do with their evil repute, and even to this day the whole class suffers more or less from the prejudices aroused by these few. Forthe most part however they were regarded with suspicion because of the mystery which surrounded their habits of life. Their sudden appearance and rapid growth, together with the absence of seeds (for their spores were quite disregarded) gave reason for distrust among people to whom the unknown was always regarded with exaggerated suspicion. Evidence of their place in popular estimation at that time comes down to us indirectly in some of the medical prescriptions of the day. When one recalls that the virtue of a medicine was then estimated almost in direct proportion to its disagreeable qualities, there can be no doubt as to the popular attitude towards the toadstool family, since they are mentioned as ingredients of those extraordinary medicines, along with ashes of worms, roasted spiders and other such unenticing morsels.

At the present day we have lost the greater part of our dislike for these lowly plants and are disposed to regard them without particular aversion, considering them harmless for the most part, but quite useless to the world. Our attitude in general is that if they were all suddenly annihilated we would be neither worse nor better off. A close study of these very interesting organisms, however, discloses the fact that they play a very important part in nature's economy and are quite as necessary to the carrying out of her grand scheme as the larger and more imposing plants.

The first striking fact that meet the attention of the person who studies the toadstool family more in detail is that the part of the fungus usually seen, whether it be in the case of morel, puffball, toadstool, shelf-fungus or mushroom, is not the most important part of the plant. Before this visible part can be produced the fungus grows for a long time in the ground, in the rotton log or stump, in the fallen branch, or in the leaves and vegetable matter of the forest soil. Throughout these substances the fungus penetrates in long slender filaments which cross and weave about in the search of food, much as do the roots of trees. This under-ground growth proceeds until the whole mass of the substratum becomes interlaced with its fine delicate threads. So universal is this habit of growth that there is scarcely an inch of leafy mold or decaying wood free from one or more kinds of fungus filaments. In this condition the fungus may exist for years or months without ever sending up the spore-bearing part with which we are more familiar, or giving any external sign of its presence..

It is evident then that the underground stages of fungi both because of their long-continued presence in the substratum and universal occurrence must be of more consequence to the rest of the plant world than the rather rare and short-lived spore-bearing part. From such considerations. a very natural line of inquiry leads one to consider the food habits of the fungus threads and it is here that the usefulness of the family in nature becomes apparent.

As every one knows, a great deal of all vegetable matter is carbon, a fact which needs only the mention of charcoal to be quite evident. This carbon can be obtained in quantity from only one source—the air. The carbon dioxide of the air is absorbed by the green plants and manufactured into its tissues, wood, bark leaves, etc. It is easily demonstrated that about half the dry weight of a tree is pure carbon all of which must have come originally from the air. The amount of carbon that is thus "bottled up" in all the forests, fields and prairies of the world is simply enormous, and when each season's growth is considered as adding to the amount it makes one rather uneasy as to whether the supply of this indispensable material will hold out for any length of time.

When we turn to the only source of supply of this important substance—the air—it is astonishing to find that it contains but a mere trace of carbon dioxide: about a third of one per cent in fact. It is so scarce that the carbon necessary for a single ordinary tree would exhaust the supply from the air fifty feet deep over a hundred acre farm. Now if one thinks of the vast number of forest, fruit and shade trees of the land to say nothing of the grain, grass and vegetables, all of which must have a share, we begin to look forward hopelessly to a carbon famine, a very imminent time of distress when all the green things will cease to grow for lack of this indispensable material.

That such a terrible possibility has never been realized is almost entirely due to the much despised toadstool and his numerous fungus relations. Unable themselves to utilize the carbon of the air because they lack the necessary green coloring matter, they are content to use that which they find in the dead stems, leaves, etc. of other plants. By means of powerful ferments they break up the tissues of these and after using the carbon give it back to the air again as carbon dioxide. So constantly and universally is this process carried on that the supply of carbon dioxide in the air is renewed as fast as it is removed by the green plants. Thus there is a continual circulation of carbon in nature, from the air to green plants, from these to the fungi which live in them after their death and then back to the air again. It must be evident that without the presence and co-operation of these humble organisms the limited stock of carbon dioxide in the air would in a very few years be so entirely absorbed and locked up in the vegetable matter of our forests and fields that no further growth could take place. All vegetation would perish and with it all animal life including man himself.

Such is the role of the lowly toadstool and his allies, and one can hardly help feeling a considerable respect for them as they persistently and unobtrusively perform their very necessary part in the harmonious working out of Nature's great plan.

NOTES ON THE OCCURRENCE AND CONTROL OF THREE NOXIOUS WEEDS

By. P. I. Bryce, Macdonald College.

The future losses to the Quebec farmer from noxious weeds will be governed in large measure by the purity of the commercial seeds he buys. From its relation to this problem of the marketing of clean seed, a reference may be made to the operation of the "Seed Control Act of Canada, 1911."

The report of the Dominion Seed Commissioner for the years 1905-1911, recently issued, shows that there has been a marked improvement of quality in the seed grain sold in Quebec. Most dealers have taken pains, in accordance with the "Seed Control Act," to obtain seed free from weeds. No seedsmen care to keep impure stock marked, say, "This seed contains Canada Thistle, Red-Root, Pigweed and Russian Thistle." The law insists on such labelling of impure seed, and the dealers prefer to purchase and retail only perfectly weed-clean seed, and to charge more for such inspected seed.

The British and Home Market for clean seed has shown a marked increase, directly due to the passage of the "Seed Control Act."

Impure seed is sold less and less to the Canadian, but there is, unfortunately, a good market as yet in the United States, as shown by the table, for inferior qualities.

Price paid for clover seed exported 1911.

In Great Britain	$9.02
In U. S. A.	7.57
	$1.45

The benefit from the increased value of farm seeds marketed should and will accrue to the Quebec farmer if he keeps down weeds by clean cultivation, proper rotation and the use of pure seed. On the other hand, unless the average farmer takes these forward steps in crop improvement, his products will sell at lower prices, his land will give smaller yields, and his soil become sooner or later impoverished and contaminated by noxious weeds and the parasites they harbor.

The careless agriculturist will find, too, that is costs more to grow, harvest and prepare his seed crops for market, and the great Quebec crop, hay, will not maintain its value. Such losses, now being met, are due to the increased bill for cultivation, for labor, and for greater wear and tear on harvesting machinery. Weedy land means more fallow land, and in this province fallows should be unnecessary.

Aside from cultural considerations, many of our weeds are poisonous, such as Horsetail, Spotted Cowbane and Common Ragwort to cattle and horses, and darnel and cockle--seed to man.

Some twelve of these "plants out of place," those most prominent on Quebec farms, are given in the "Report of the Conservation Commission," 1911, from which I quote.

On two hundred farms surveyed, facts regarding the following weeds were gathered.

PROVINCE OF QUEBEC

Occurrence and increase of Weeds on 200 Farms.

Name of Weed.	Percentage of Farms where Present.	Percentage of Farms Showing Weed to be Increasing.
Ox Eye Daisy	84.	23.
Canada Thistle,	79.	10.
Couch Grass,	73.	21.
Pigweed,	66.	—
Lamb's Quarters,	65.	6.
Sow Thistle,	62.	13.
Wild Mustard.	58.	5.
Green Foxtail Grass,	53.	3.
Golden Rod,	31.	—
Chicory,	28.	—
Yarrow,	28.	—
Orange Hawkweed,	20.	15.

Canada Thistle.

Looking at some of these weeds, we find **Canada Thistle** (Cirsium arvense) present on 79 per cent of the farms looked over. This is a perennial of the Thistle Family which spreads by winged seeds and by stout running root-stocks. The root-stocks grow deep down in the soil as far as cultivation penetrates, and branch very freely.

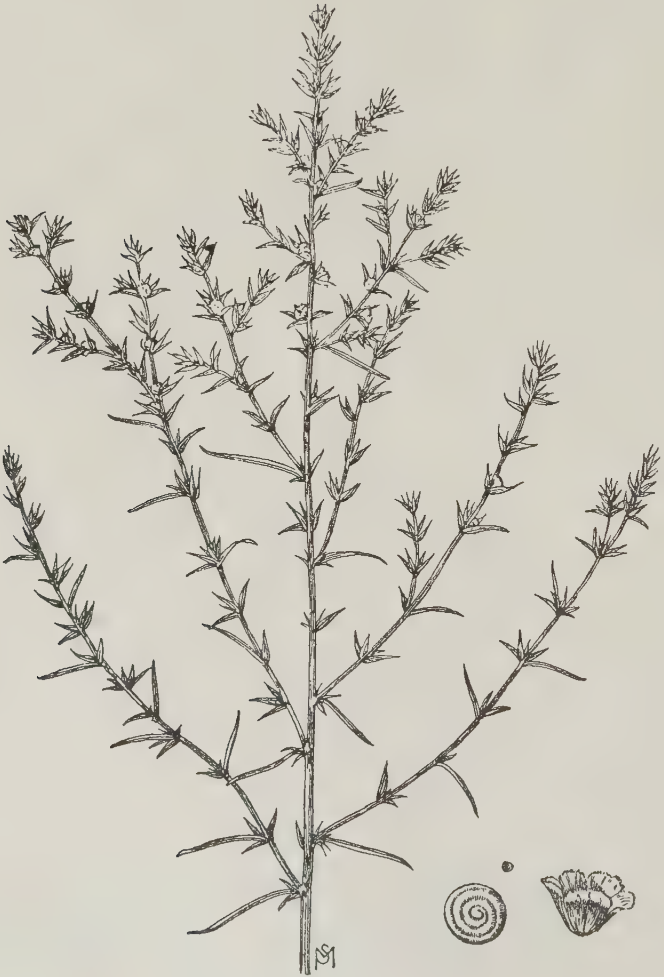
Redroot Pigweed.

The deeply-cut leaves have very wavy, crinkled edges, beset with spines which make the plant a nuisance in shocking-up grain, and a danger to live-stock if fed in hay. The flower-heads are light pink to purple, and smaller than those of Spear or Bull Thistle. The floral involucre is smooth.

The seed-bearing flower-heads are sometimes on separate plants from the pollen-bearing, and about half their size.

The seed is about 1-8 inch long, rather conical, light brown, often flattened. To destroy Canada Thistle, alternate a hoed crop with a heavy smothering crop.

Redroot Pigweed (Amaranthus retroflexus) is a coarse weed often found in cultivated crops or gardens, belonging to the same family as the garden Celosia and the Amaranths. It is a leafy annual with a strong reddish tap-root. When mature, the stem is very woody, and the seed is surrounded by short sharp bracts. The minute flowers produce very abundantly smooth, shining, black, lens-shaped seeds, 1-16 inch across.



Russian Thistle (Salsola Kali-tragus.

Because of its size and vigorous growth Redroot is dangerous both to seedlings and to later stages of farm plants.

Pigweed harbors the White Rust (Cystopus bliti) from which Coxcombs and Amaranths are liable to infection.

Clean seed and cultivation with fall plowing will keep this weed under control.

The **Golden Rods** (Solidago sp.) belonging to the Thistle Family are a pest in the low-lying meadow and pasture land. The most annoying species are perennials, such as Solidago graminifolia, Bushy Goldenrod. Occasionally one sees pastures fairly overgrown with solid masses of this tall, woody, and evil-tasting weed. The pollen of the Goldenrods is believed to be irritating to those liable to hay fever.

The cultivation and seeding down of infested pastures destroys the root-system and kills out the weed.

While the wide notoriety given the **Russian Thistle** (Salsola kali) in Manitoba has made it seem more dangerous than it really is, it has some features of a noxious weed. It is really no thistle at all, but a relative of Lamb's Quarters, and belongs to the Spinach family.

The plant is a bushy, much branched annual, with reduced, succulent, sharp-pointed leaves. The seed-pod grows in the leaves of hard, spiny bracts, which make the plant a nuisance to the legs of horses and cattle.

When mature, the plant often breaks off near the ground and is rolled away by the wind, dropping its seed from time to time. It is, in fact, a tumble-weed and so more to be feared. In Quebec it is said to be present on 62 per cent of the farms (Report Com. Conservation, 1911). When young it should be hand-pulled and kept down by the cultivator. Early fall plowing will germinate much of the seed, and frost then kills the seedlings.

Most cultivators now know that certain chemicals applied in a fine spray will kill weeds among grain or grass crops. Where spray pumps are available this method of control is growing fast into popularity. Three of the more useful substances are arsenite of soda, using 1 and 1-2 lbs. in 50 gallons of water; arsenate of soda, 1 lb. in 8 gallons of water, and sulphate of iron or green vitriol crystals, applying 100 lbs. in 50 gallons of water.

Spray on a still day after rain, or in clear weather. Grasses are not readily affected, but clover meadows must not be sprayed or the clover will be killed. Spray when the weeds are young.

Keep the following rules in mind to suppress weeds.

1. Buy, sell, and sow only clean seed, and that more heavily.
2. Use a proper system of culture rotation including a hoed crop.
3. Keep roadsides, fences and hedgerows free from weeds.
4. Never let weeds go to seed.

SLIME MOULDS AND THEIR ECONOMIC IMPORTANCE.

By J.W. EASTHAM, Chief Assistant Botanist, Central Experimental Farm, Ottawa.

The Slime Moulds (**Myxomycetes** or **Mycetozoa**) are a group of organisms not so well known as they deserve to be to students of plant life. The delicacy and variety of their fruiting stages will well repay study on the part of anyone possessed of a microscope or even of a good pocket lens, while in their life history they show a most curious succession of phases and offer to the Biologists a presentation of the question "What distinguishes a plant from an animal?" in a form which has as yet eluded a satisfactory answer. The scientific names applied to the group are in fact indications of this ignorance on our part of their true nature, for the name Myxomycetes means "Slime-fungi" and that of Mycetozoa is literally "fungus animals". The former term accords with the view that these organisms are plants, the latter with the opinion that they are to be considered of the nature of animals. Both names suggest a close relationship with the fungi, and they will usually be found classed with this group in the larger systematic works, although fungi in the strict sense they certainly are not. It may perhaps suffice for our purpose if we say that they are organisms possessing at different stages of their history some of the well-marked attributes of plants and animals respectively, but in their mature form at any rate showing on the whole a closer relationship with the former than with the latter.

The life history of a typical slime-mould is briefly as follows:—As in the case of most of the simplest plants reproduction is effected by spores. These are produced in great numbers, are generally spherical, and have a typical vegetable characteristic in that the wall or containing membrane of each spore is composed of cellulose. Under suitable conditions, principally a slight amount of warmth and moisture; the spores germinate; the wall cracks and the living protoplasmic contents of the spore slips out into the surrounding water as a minute colorless body of indefinite form. It possesses a considerable degree of activity, creeping along by the protrusion of certain portions of its substance or swimming along through the water, being in the latter case propelled by whip-like lashings of a delicate thread of protoplasm pushed out at one end. At this stage the organism bears a very close resemblance to some of the simplest animals and hence it is termed a "zoospore" or "animal-spore." The zoospores may multiply by the simple process of each dividing into two, but ultimately, however, a number of them come together and coalesce almost like so many drops of water, forming a large protoplasmic mass termed a **Plasmodium.** This plasmodium rapidly increases in quantity—one can hardly say size—feeding on solid particles of vegetable débris. These are taken into the substance of the plasmodium and then digested which is certainly a very animal-like method of nutrition. The plasmodium of certain species may reach a very large size, irregularly covering a square foot or more of decomposing vegetable matter. It is of about the consistency of white-of-egg—(hence the name slime-moulds) and slowly moves along in a kind of creeping fashion, being attracted by moisture and repelled by light. After a certain length of time the instincts of the plasmodium seem to change. Then it emerges from under fallen leaves or the interior of a rotten log and crawls into the most exposed position available, often climbing up the stems of adjacent plants for some distance. The reason is that spore-formation is now about to take place and in order that the spores may have a good chance of being scattered it is desirable that they should be set free when air currents can reach them freely. The plasmodium may now form a large number of distinct fruiting bodies (sporangia) often showing great beauty and intricacy of structure, or may simply solidify, as it were, into one firm mass with the interior more or less distinctly divided into small chambers, each corresponding to a sporangium. In either case each sporangium contains an enormous number of spores usually together with certain thread-like structures, and in course of time the spores are scattered by atmospheric agents and the life history is begun afresh. The time taken to pass from spore to spore formation again may be only a few days or it may be many months, depending partly on environment and partly on the species.

As has already been mentioned slime-moulds live typically amongst decaying vegetable matter, being especially fond of moist rotten logs and masses of decaying leaves in woods. Here, no doubt, they play to some extent the same role as many fungi, gradually helping to decompose the vegetable matter and bring it once more into a condition to be utilized for food by the higher plants. They are therefore to this extent useful. There are, however, a number of organisms usually classed with them which are parasites of other plants, and two of these are the cause of important diseases of crops in this country. These organisms are markedly different from other slime-moulds, but we know that the adoption of a parasitic habit generally results in profound changes in the structure of an organism, and it is only to be expected that the life history of an organism passed inside the cells of another plant should be very different from that of such an one as we have described above. In particular the complex fruiting bodies of a typical slime-mould would not be required. At all events these parasitic forms are more closely related to the slime moulds than to any other group, so far at least as our present knowledge goes, and are most conveniently classified with them. We will now consider in detail those forms which are of economic interest in this country.

PLASMODIOPHORA BRASSICAE Wor.

This attacks many species of plants, both wild and cultivated, all however belonging to the family **Cruciferae**, and produces a disease known by the English names of "Club-root," "Finger and Toe" and (in Britain) Anbury. The two former of these names indicate the peculiar malformation which takes place in the root system of an attacked plant, a malformation which varies with the kind of plant and extent of the disease, but generally shows as a finger-like swelling of the branch-roots. The first infection probably occurs by a "Zoospore" such as we have described entering a cell of the plant by a root-hair. Inside the host-cell a plasmodium is formed, the cell is stimulated to rapid division, each new cell containing a portion of plasmodium. By this rapid growth of the tissue a swelling results, the cells of which are infected by the parasite. Only the roots are attacked, but as a natural consequence the ability of the plant to absorb water from the soil is reduced and "wilting" ensues, this being usually the first symptom of disease observed. If badly attacked the plant does not develop properly but remains stunted, and finally the roots decay into an offensively smelling putrid mass. In the meantime the plasmodium inside the infested cells has undergone spore-formation, such cells under the microscope being seen to be packed full of myriads of exceedingly small spherical spores. When the roots decay these spores are set free into the soil and by the various tillage operations become distributed through the land. Each in course of time will, if conditions be favourable, germinate and produce a new infection. Even after the lapse of several years soil infected with spores will still produce diseased plants, although it is not quite clear in what form the parasite exists during this time. The disease i very bad in the Maritime Provinces, and also occurs elsewhere in this country and may be looked for especially in the market gardening areas near large towns. In the United States it is particularly serious in such localities e.g. in the vicinity of Buffalo and New York City..

Among cultivated plants the following are known to be attacked:—cabbage, turnips, swede, Kohl-rabi, cauliflower, Brussels-sprouts, rape, radish and white mustard; and amongst weeds, charlock, ball mustard, penny cress, worm-seed, mustard, false flax, tumbling mustard, shepherd's purse, hare's ear mustard, and others.

Control. Although it has been stated above that no part of the plant except the root is attacked yet there is evidence to show that the disease can be spread on the seed. It will be easily realized that if the soil is full of spores, these may be carried to the seed pods in the dust raised in cultivation and blown by wind and some may be mixed with the seed in the process of threshing. Hence if it is not possible to secure seed from a locality known to be free from the disease it is advisable to disinfect it by soaking it for 15 minutes in a solution of one part by weight of corrosive sublimate in 1000 of water. Besides killing the spores of this disease, this treatment is effective against the germs of certain other diseases and does not injure the germination of the seed.

If diseased roots are fed to stock the spores are liable to escape injury from the digestive juices and to pass out into the manure with undiminished power of producing infection, and such manure would become a most effective means of spreading the disease. It is therefore highly advisable to boil or steam the produce from a diseased crop of "roots" before feeding it to stock. Rotation is very important, the disease gradually increasing in severity when cruciferous crops succeed each other on the same land at too short an interval until they cannot be grown at all. From 4 to 6 years should elapse between such crops and since many weeds can become infected and harbor the disease from year to year we have here an additional reason for clean farming. Applications of lime to infected soil at the rate of two to three tons per acre are of great value in reducing the severity of the disease. The lime should be applied twelve to eighteen months previous to the sowing or planting of a cruciferous crop.

In some recent experiments conducted by the Division of Botany, Ottawa, on very badly infected land in P.E.I., it was found that while untreated land sown with turnips yielded only 4800 lbs. of sound roots per acre, where lime was applied at the rate of 100 bushels per acre the yield of sound roots was increased to 15,550 lbs. per acre. It was also found that this quantity of lime gave a better yield than did the amount of 150 bushels and 75 bushels per acre respectively.

Spongospora subterranea (Wallr.) Johns. This produces the disease of potato tubers known as Powdery or Corky Scab. The disease is well-known in Europe but was first definitely identified in Canada in the Autumn of 1912. It is now known to occur in the Provinces of P.E.I., N.S., N.B., Que., Ont. and Alta, being most abundant apparently in Quebec. Whether the disease has really been introduced only in the last few years or whether it has been established—in Quebec at any rate--for many years is a point difficult to determine with any degree of certainty, owing to the close resemblance which it bears to the almost universal Common Scab (due to **Oospora scabies** Thax). To the practised eye, however, there are certain differences usually quite sufficient to distinguish the two even without the assistance of a lens, though on the other hand cases may occur, as for instances with potatoes that have been handled, where even the use of the microscope is not sufficient to enable one to make a satisfactory decision. A typical mature Powdery Scab pustule differs from one of common Scab in usually being more raised and having a more even margin. The surface is formed by a smooth membrane instead of being rough and irregular. When this membrane is broken the pustule is seen to be filled with a characteristic brown or greenish powder, which is composed of spore-balls. If this be rubbed away it will be found that the pustule is marked off from the underlying healthy tissue by a well-defined smooth corky layer. In diseased tubers that have been much handled this is often the only remaining indication of the disease. In the earlier stages of a mild attack the scab spots may not be much larger than a pin head but as they increase in size they may coalesce until a considerable portion of the tubers is covered with large diseased areas. In severe attacks the tubers are stunted and very much deformed so that they are practically worthless. All the details of the life history of the parasite are not known but it appears probable that a zoospore obtains entrance into a cell through the thin skin of the young tuber, gives rise to others and ultimately to a plasmodium. As in the case of Club-Root, cells so infected divide more rapidly than healthy cells, and a mass of tissue is formed which projects as a scab or pustule but which is covered by the unbroken skin of the tuber. Each cell of this tissue contains a plasmodium which finally changes into a mass of spores, a change followed by the collapse of the host cells so that the pustule becomes filled with the loose spore-balls forming the powder previously mentioned. It will be seen that the life-history closely resembles that of the Club-root organisms, the chief difference being that in the latter myriads of separate spores are formed, while in the former all the spores from one plasmodium adhere together as an irregular rounded mass,—the spore-ball.

Control. No effective control measures are known, and since the disease is capable of proving very serious it is desirable to take all possible precautions against its introduction into uncontaminated land. To this end it is best if possible to procure "seed" only from localities where the disease is known not to be present. As this however is not always possible "seed" potatoes should be selected which are quite sound and then treated with formalin or corrosive sublimate in the way commonly practised for common Scab. The reason for this is that perfectly sound tubers from a crop which contained diseased ones may have many spore balls adhering to them which would introduce the disease into the soil. Similar treatment of tubers which actually have the disease even in a mild form will not render them safe to use for planting as it seems probable that the parasite may exist to some extent in the living cells near the scabs and not be reached by the treatment.

In order to restrict as far as possible the spread of the disease when it is known to exist on a farm it is important that special care should be taken in the disposal of diseased potatoes, peelings etc. Moderately attacked tubers may be used for table purposes but the peelings should not be thrown on the manure pile or fed to animals without being boiled. In the same way all tubers fed to animals should be boiled first as the spores may resist the digestive juices and pass out into the manure with unimpaired vitality. The manure in such a case will be an effective means of spreading the disease. Cellars, etc., where affected potatoes have been stored, should be washed down with a strong solution of formalin, and bags, baskets, etc., should be dipped in a similar solution. The spores may retain their vitality in the soil for an undetermined length of time, and although no other crops are known to suffer from the same disease, yet in order to reduce the possibility of conveying spores to other fields on implements, etc., it is advisable when not involving too great a loss to put the infected areas to grass, clover, or alfalfa.

MUCILAGO SPONGIOSA (LEYS) Morg. SPUMARIA Alba (Bull). D. C.

This is one of the commonest and most conspicuous slime-moulds. The plasmodium forms large dull-whitish masses spreading over dead leaves or similar vegetable matter. The fruiting bodies form large elongated masses, as much as three inches long, attached to stems of grass and other plants, sticks, etc. Externally they are covered with a thick white crust composed of minute crystals of carbonate of lime while the interior is divided into rather indefinite small chambers filled with violet black spores. This organism is not parasitic, but is occasionally found in large numbers in strawberry beds, living probably on the manure. The plasmodium is stated to be sometimes present in such quantities as to interfere with the formation of fruit. In any case both the slimy plasmodium and the sooty spore powder are quite objectionable among ripening strawberries. Spraying with a solution of 1-2 oz. of potassium sulphide (liver of sulphur) in a gallon of water is an effective remedy.

Physarum cinereum (Batsch) Pers. During the past season several inquiries were received by the Division of Botany at the Central Experimental Farm, Ottawa, with reference to a disease affecting lawns. The slime-mould named above appears to have been so favoured by the continuous wet weather that prevailed for a large part of last summer that its small grey roundish fruiting bodies literally covered every blade of grass in patches of considerable size in certain lawns, in some cases rather to the alarm of the owners. The organism, however, is not parasitic and beyond a certai amount of disfigurement would not cause any injury. Like the last it may readily be controlled by spraying potassium sulphide or by sprinkling the lawn lightly with potassium nitrate (Common Saltpetre).

AN OLD ENEMY OF THE POTATO

By J. C. Chapais, St. Denis, Que.

SUMMARY—The Meloidae.—Classification.—Genera of Meloidae which are noxious to the Potato.—The Ash Gray Colored Blister Beetle.—The Black Blister Beetle. — The Gray Blister Beetle. — Concerning the Meloidae.—Best ways to fight against the Meloidae.—Reasons that have led to the writing of this Paper.

The Meloidae. Those of my hearers who are young will probably think while reading the title of the present paper that I am going to speak of the Doryphora decem-lineata which they ought to consider an old enemy of the potato, as it came into our province in 1876 after having invaded Ontario in 1870. It is not, however, the one about which I am going to speak, for the enemy against which I am going to wage war to-day is more ancient than that, and had grappled with the potato a long time before the chrysomela, I am going to denounce the depredations committee, now and then, by the name of the Meloidae, a family of Coleopterous insects, of which many species are found, as will be mentioned below, three proving to be noxious in our province.

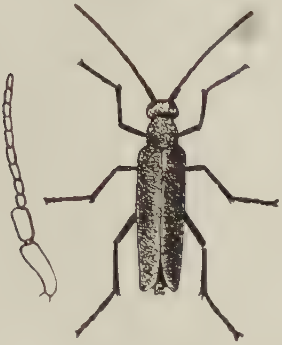
Classification. I will first begin by giving a description of the insects which form the subject of the paper I now present to my hearers, and show what they are from the viewpoint of the science of entomology. The various species of these insects belong to the family of the **Meloidae,** the order of the COLEOPTERA **Heteromera,** the class of **Insects** and the phylum of the **Arthropoda.**

The genera Meloe, Macrobasis, Epicauta and Pomphopoea of that family are said by Gibson to contain sixteen species in North America.

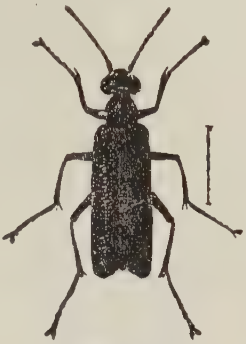
Genera of Meloidae which are noxious to the Potato. Of these sixteen species of insects of the Meloidae family, three only are known as being noxious to the potato. Before speaking of each one of them individually, I will first indicate the characteristics common to all the insects of the Meloidae family.

Meloidae. Head strongly bent, bluntly narrowed into a neck disengaged from the prothorax; **Antennae** composed of 11 joints inserted in the sides of the forehead before the eyes; PROTHORAX narrower than the ELYTRA without any lateral sutures, its cotyloid cavities large, confluent, opened; **Elytra** generally flexible without well distinct Epipleurae; abdomen with 6 free segments; **Legs** long, the 4 fore-hips large, conical, contiguous; The hind-hips transverse, prominent, almost contiguous; **Tarsi,** the fore-ones with 5 joints, the hind ones with 4 CLAWS cleft or toothed at the base (Prov.).

Insects of the average size or a little over, found on plants rather remarkable on account of the softness of their teguments. Most of them have an epispastic or vesicant virtue made use of for a long time by doctors. The cantharides of pharmacies came from tropical countries and more particularly from Spain. Our Lyttae have also the same virtue but in a lighter degree of intensity. Hence the English appellation of Blister-beetle **Coleoptére Vesicant,** given to those insects.



Ash-Gray Blister Beetle



Black Blister Beetle

We will now proceed to the description of the three species which are of some interest for us. They are the following:

Scientific Names	**English Names**	**French Names**
Epicauta cinerea	Ash-gray colored Blister-beetle	Epicaute gris-cendré
Macrobasis unicolor	Gray Blister- beetle	Epicaute noir
Epicauta pennsylvanica	Gray Blister-beetle	Macrobase unicoloré

The Black Blister Beetle is of a uniform ash-grey color with a body varying from one-third to one-half inch in length. It visits us generally in August.

The Ash-Grey Blister Beetle is black in colour and uniformly clothed with a grey pubescence, with a body from three to five eights of an inch long. It appears in the hot days of July.

The Grey Blister Beetle is of a uniforn ash-grey color and of a little larger size than the preceding one, its body varying from half an inch to five eights of an inch in length. It is with us during the hottest days of July.

Characteristics of the Meloidae. The insects which we are studying lay their eggs in summer superficially in the soil where they hatch and where their larvae undergo very interesting metamorphoses. They enter first into the stage of "triungulin", then assume the form of "carabioid," followed by the form of "scarabeoid," to become, after that, a pupa and finally a perfect insect. As larvae they penetrate into the oothecae or egg-cases of some Orthoptera and prey upon their eggs, as, for instance, upon the eggs of grasshoppers **(Caloptenusfemur-rubrum)** which sometimes devastate our crops.

Unfortunately after having done such good work they become injurious when in the condition of perfect insects they attack our potatoes, tomatoes, etc., stripping them of their leaves in two or three days, even before those who have no knowledge of them suspect their presence. They come in large swarms and don't stay long, getting through a great deal of work in a short time.

Gray Blister Beetle

Best Ways to Fight against the Meloidae. From what has been said above about the larvae of the Meloidae, one may come to the conclusion that there is no need to fear them before they assume the condition of perfect insects. This shortens very luckily the time during which we must take measures for destroying them.

On the farms where spraying with poisoned Bordeaux mixture is resorted to as a means of getting rid of the Doryphora and of the various rots and other diseases of the potato, there is no need to look for some other method against the attacks of the Meloidae than that of using this mixture of which I give here the formula:

Copper sulphate (blue stone)	4 lbs.
Lime (fresh)	4 lbs.
Paris green	4 oz.
Water (1 barrel)	40 gallons.

As the attack of the Meloidae is quite sudden and as they are highly voracious, one should be very prompt in making the application of that mixture at the moment their presence is pointed out.

As the Blister-beetles are very easily disturbed, the following method is often used with success. It consists in using two or three boys, or even more if necessary, to walk through an infested field and wave from side to side boughs of spruce or other branches. Such an operation will drive the beetles ahead of them and when the insects come to the edge of the field they will disperse and seldom return, especially if care is taken to place at the end of the field a windrow of straw which harbours the insects, where they are burnt by thousands if the straw is set on fire.

In the garden, many of these insects may be killed by beating them from the plants into pans containing water with a little coal oil on the surface.

Reasons that have led to the Writing of this Paper. In closing this paper, I beg leave to say that two reasons have induced me to write it. The first is that I felt the need of compiling, from many papers, reports and bulletins published in Canada and the United States on that matter, a summary of the knowledge we obtained from many sources concerning the family of the Meloidae, when we wanted to learn something about them. The second reason is that almost all the literature we have on that subject is written only in English, a thing which prevents our French farmers, who, many of them, have no more knowledge of the English language than have our friends the English farmers of the French, from reading all they should know about those enemies of their potatoes. By publishing the French version I have prepared of that paper in the French edition of the report of our Society, I give them a chance of getting some information on that subject.

DISEASES OF FOREST AND SHADE TREES

By. W. P. Fraser, Macdonald College.

Forest and shade trees are subject to many kinds of disease. This paper deals only with a few of those caused by flowering plants and fungi, more especially with the diseases caused by rusts and shell or pore fungi.

DISEASES CAUSED BY FLOWERING PLANTS

Arceuthobium pusillum—Dwarf Mistletoe. The most serious disease of trees in Canada due to flowering plants is that caused by the Dwarf Mistletoe. This parasite is generally distributed in the spruce woods of Eastern Canada, attacking especially the black spruce. The diseased trees can be recognized by the developmen of witches' brooms, close clusters of bushy twigs. An examination of these bushy masses will show short, greenish, leafless stems half an inch or less in length growing from the bark; these are the stems of the mistletoe. The flowers are produced in early spring about the time the alder is shedding its pollen. When the seeds are ripe they are projected from the capsule and adhere to the bark of neighbouring branches and there germinate. Growth takes place into the bark, a connection is established with the living twig and in time the witches' broom is formed. The parasite spreads slowly over the tree and eventually kills it. The disease could doubtless be held in check by cutting off the witches' brooms before the seeds ripen.

DISEASES CAUSED BY FUNGI

Powdery Mildews (Erysipaceae). The powdery Mildews are common and generally distributed. Several species attack the leaves of trees. The diseased leaves are covered with a whitish mould which appears powdery when the summer spores are present. The poplar, willow, oak, maple and birch suffer most, but usually the injury is slight except in the case of young trees. Where these fungi attack nursery stock, dusting with sulphur will help to check the disease. Spraying with lime sulphur would probably also be effective.

Tar Spot of Maple (Rhytisma acerinum). This fungus is very common on the leaves of maples, especially in damp situations. It causes conspicuous black angular spots on the upper surfaces. Sometimes the attack is so severe that the leaves fall prematurely. During the winter and the following spring spores develop in the black areas. These are mature by June and thus the fungus is carried over the winter and infects the leaves in the spring. Gathering and burning the leaves where practicable would help to control the fungus.

Rust Fungi. The rusts constitute a large group of fungi which are parasitic on flowering plants and ferns. Their structure consists of an inconspicious mycelium in the tissues of the host plant and more or less conspicuous spores that usually break through the epidermis and appear as powdery masses or crusts. Spores of five kinds may be produced though they are not all present in every species. These spores always follow each other in a definite order; first the spermatia, which as far as is known have no function and take no part whatever in the development or spread of the fungus. Aecidiospores or spring spores soon follow and later uredospores or summer spores are produced. These are followed by teleutospores or winter spores whose function is usually to carry the fungus over the winter, though in some species this is not the use of the teleutospore. The teleutospores under favourable conditions which vary in the different genera and species send out a tube and on this spores called sporidia or basidiospores are produced which cause infection. One or more of the spore forms may be absent in certain genera or species except the teleutospores, but the spore succession is always the same.

Many rusts pass part of their life cycle on one plant and part on another species, and usually these plants are not closely related. The former rusts are called heterœcious and the latter autoecious. In the heteroecious rusts the spermatia and aecidiospores are developed on one host and the uredospores and teleutospores on the second host. Most of the rusts that attack trees are heteroecious or two host rusts. The following are the most common and injurious species attacking trees in Canada.

(a) **The Rust of Poplar and Hemlock (Melampsora medusae).** The aecidiospores or spring spores of this species are common on the cones, young leaves and twigs of the hemlock (Tsuga canadensis). The parts attacked turn yellow, the twigs curl up, the leaves fall and the cones do not mature. These spores are produced in June and they are carried by the wind to the young leaves of poplars and yellow dusty spores, the udespores or summer spores soon appear on leaves. Later the winter spores are formed on the leaves in crust-like masses. The infected leaves soon turn black and fall from the trees. These teleutospores or winter spores carry the fungus over the winter and infect the hemlock in the following spring. In the western United States this species of rust has its spring spores on the larch instead of the hemlock.

(b) **The Rust of Larch and Willow (Melampsora Bigelowii).** This rust much resembles the last, but attacks the larch (Larix laricina) and produces the spring spores on its leaves. The summer and winter spores are found on the willow (Salix species).

(c) **The Rust of Willow and Balsam Fir. (Melampsora arctica).** Spores of this rust are produced on the fir, Abies balsamea. The stages on the willow are so much like the last species named that it is difficult to distinguish them.

(d) **The Rust of Balsam Fir and Blueberry** (Calyptospora columnaris). The aecidiospores are produced in the leaves of the balsam fir, but no spermatia are formed. The spring spores reach the blueberry and attack them. The infected stems assume a brown, shining swollen appearance and are almost destitute of leaves. The teleutospores or winter spores are produced in immense numbers in the epidermal cells of the swollen stems. The mycelium is perennial in the blueberry and spore production takes place each year without new infection. Uredospores are never formed.

Beech Tree with Fruiting Bodies of Fomes Fomentarius (After Von Schrenk).

(e) **Rust of Spruce and Labrador Tea** (Melampsoropsis ledicola) The spring spores of this species are sometimes so abundant on young spruces that they present the appearance of having been swept by fire. These spores carry the fungus to the Labrador tea (Ledum groenlandicum).The mycelium lives in the leaves of this plant till the following spring and in June abundant teleutospores are produced on the upper side of the leaves. These germinate on the leaves and produce sporidia which are carried by the wind to the neighbouring spruces. The aeciospores are usually mature on the leaves of the spruces by the middle of July.

(f) **Rust of Spruce and Labrador Tea** (Melampsora abietina.) This fungus much resembles the last in habit and life history. The teleutospores, however, are developed on the under side of the leaves. This fungus is also common in eastern Canada.

(g) **Rust of Spruce and Leather Leaf** (Melampsoropsis Cassandrae). This species resembles the last two in habit, the spring spores being produced on the various species of spruce, but the summer and winter spores are found on the leather leaf (Chamae daphne calyculata).

(h) **Rust of Larch and Birch** (Melampsoridium betulinum). The summer spore stage attacks the leaves of the birches and causes them to turn yellow. The aecidial stage on the larch has not yet been collected in North America.

(i) **Rust of Fir and Chickweed** (Melampsorella elatina). The aecidial stage of this species causes conspicuous witches' brooms on the balsam fir. These are quite common in Eastern Canada. The uredospore and teleutospore stages are found on the Chickweed. They are inconspicuous and rarely collected.

(j) **Rust of Spruce Cones and Pyrola** (Melampsoropsis pyrolae). This rust is rather common locally on the cones of the spruces in some regions of the Maritime provinces. It is also probably common in the coniferous regions of Quebec. The spores are produced in great abundance on the scales of the cones. The uredospores appear on the leaves of Pyrola plants in early spring. They are soon followed or accompanied by the teleutospores, which germinate about the 24th of May on the host plant. The sporidia are carried by the wind to the cones of the neighbouring spruces, and by the first of July the stage on the cones is mature.

(k) **Rust of Balsam Fir and Willow Herb** (Pucciniastrum pustulatum). The aecidial stage of this species occurs on the leaves of the balsam fir during June. Later in the season the uredospores and teleutospores develop on the leaves of the willow herbs (Epilobium).

(l) **Rust of Hemlock and Blueberry** (Pucciniastrum myrtilli). This rust is very common on the leaves of hemlock in many regions in eastern Canada. The uredospores and teleutospores are produced on the blueberry. They are also found on the huckleberry. The spring spore stage of the hemlock is usually passed as Peridermium Peckii.

(m) **Rust of Hemlock and Rhodora** (Pucciniastrum minimum). This species closely resembles the last one described, but the uredospores and teleutospores are developed on the Rhodora (Rhodora canadense).

(n) **Rust of Balsam Fir and Ferns** (Uredinopsis). Several of the fern rusts of the genus Uredinopsis have their spring spore stages on the balsam fir. These stages are usually placed in the form genus Uredinopsis. They are very common on the fir in the coniferous regions of eastern Canada. They are characterized by white spores. The uredospores and teleutospores are common on several species of ferns. The attacked fronds show white areas.

(o) **Rust of Ash and Marsh Grass** (Puccinia peridermospora). Both stages of this rust have been collected in the vicinity of Ste. Anne's. The spring spore stages occur on the leaves of the ash; the other stages are common on a marsh grass. (Spartina Michauxiana).

Cross Section of the Trunk of a tree rotted by the White Heart Rot. Fomes Igniarius. (After Von Schrenk.)

(p) **Rust of Bull Pine** (Peridermium Harknesii). This is a very destructive rust attacking the bull pine in the Rocky Mountain regions. The mycelium is perennial in the infested part and causes large galls on the limbs. It also attacks the stems of young pines and thus soon leads to their death. The winter spore stage is not known.

(q) **The Blister Rust of White Pine and Currant** (Cronartium ribicola). This very serious rust of the white pine has been introduced from Europe and has established itself at Geneva, N. Y. It has also been introduced into Canada with imported nursery stock. Attempts have been made to eradicate it in Canada but with what success the writer is not aware. The spring spore stage attacks the bark of the white pine. The bark swells and for a time the mycelium develops. Eventually the spring spores are produced in yellow pustules on the bark. The fungus frequently attacks the stems of young trees and soon kills them. The life cycle of the fungus is completed on some species of the genus Ribes which include the wild and cultivated currants and gooseberries. The uredospore and teleutospore stages are quite conspicuous on the under side of the leaves. Professor Stewart of the Geneva Experimental Station believes that the only way to control the disease in North America is the destruction of the cultivated black currant which he believes to be the chief factor in the spread of the disease in North America. Compared with the white pine the black currant is of little importance. In time, if it has not done so already, the disease will reach Canada and it is important that measures be taken to hold it in check. The spread of this disease in the white pine forests of Canada would be serious.

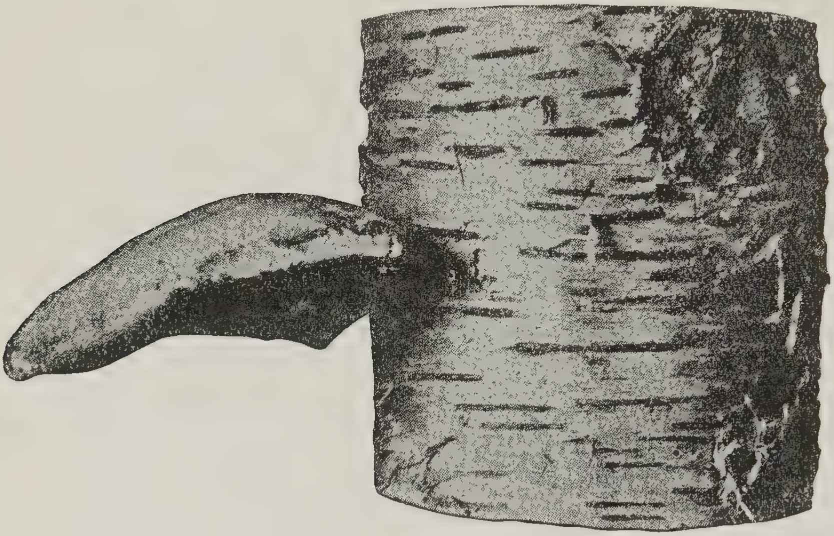
(r) **Rust of the Hemlock.** (Necium Farlowii.) This is an example of a one host or autoecious rust. Only one spore form, the winter spore, is present in the life cycle and this attacks the cones and twigs of the hemlock. The writer found it locally abundant but not wide spread in the Maritime Provinces. Many of the young hemlocks were stunted from the death of the twigs.

Measures for Control of the Rusts. The destruction of one of the hosts in the case of heteroecious rusts will usually cause the rust to disappear. For example, in the case of the rust that attacks the spruces and the Labrador tea, the destruction of the latter which is of no economic importance would lead to the disappearance of this rust. In species with perennial mycelium the fungus might persist in spite of the destruction of one host. Another means of control is the destruction of the parts that bear the winter spores, such as the leaves. These may be gathered and burned. Usually only a knowledge of the life history of each species will alone suggest some means of holding it in check.

GILL AND PORE FUNGI.

(a) **Root Rots.** One of the most common and destructive root rots of trees in Canada is that caused by one of the gill fungi or mushrooms, the honey agaric (Armillaria mellea). The mycelium of this fungus enters the roots, grows into the cambium and attacks the living cells; finally the tree is encircled by the fungus and eventually dies. The fungus keeps on growing in the dead root system and produces its fruit bodies abundantly. It also spreads by strands of mycelium to the roots of neighbouring trees. The fungus is very common, especially in groves of trees surrounded by open fields.

Another common root rot of coniferous trees is due to a pore fungus, Polyporus Schweinitzii. The place of attack is the root, from which it passes to the trunk. The decayed wood becomes brittle and yellow. The fruiting bodies are large, dark brown, and somewhat spongy in texture. They may be sessile or stalked. The spore bearing surface is brownish with a rose tint when young. It rapidly turns dark when bruised. In Europe it is usual to prevent the spread of the disease by trenching. Infected trees should be destroyed.

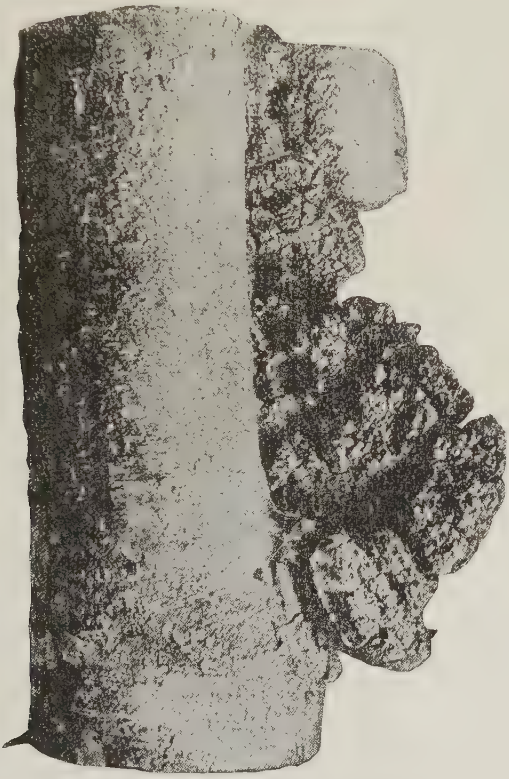


Polyporus betulinus.

Heart Rots. Among the most serious diseases of trees are the heart rots, usually caused by some species of the pore fungi. The mycelium enters by a wound and grows into the heart wood, penetrating through or among the cells. It produces substances that break down the cells, and the wood disintegrates. The fungus spreads until the tree is ruined for timber. Usually the fruit bodies of the fungus do not appear until the decay is far advanced.

(b) **The White Heart Rot** (Fomes igniarius). The most serious of the heart rots in this region is that caused by the pore-fungus (Fomes igniarius). It attacks all broad-leaved trees but in Eastern Canada the beech suffers most, while in the west it is most common on the poplar.

The centre of the attacked tree becomes reduced to a whitish pulpy mass of decayed wood bounded on the outside by one or more narrow, irregular black bands. The fruit bodies are produced on the trunk. They are hoof-shaped and in old specimens the upper surface is black in color and much roughened and cracked. The lower surface is brown and thickly set with small pores on the walls of which vast numbers of spores are produced. The fruit bodies are perennial. Each year a new pore bearing layer is added. A closely allied species of fungus (Fomes Everhartii) causes a heart rot of the yellow birches, accompanied by irregular, black jagged masses having the appearance of large warts. These are probably abortive fruit bodies. Since the white heart rot is a wound fungus, one means of control is the prevention of wounds. This is not always possible especially in large forest areas. The best method of combating the disease is the removal of the sources of infection, the diseased trees. Removing the fruiting bodies may be of some value but many of them may be overlooked or be inaccessible, and in any case they will soon be renewed.



Abortive Fruiting Body of the White Heart Rot. Fomes igniarius. (After Von Schrenk).

(c) **Red Heart Rot.** This disease of deciduous trees is caused by one of the pore fungi (Polyporus sulphureus). The heart wood of infected trees becomes a mass of reddish brown wood which is characterized by radial and concentric cracks. These cracks become filled with thin sheets consisting of interwoven threads of the fungus. This fungus does not seem to be very common in Canada.

(d) Sapwood Rot Fungi.

(1) **Fomes fomentarius.** This fungus is very common in Canada, occurring chiefly on the beech and the birches. The fruit bodies or sporophores are hoof-shaped, the upper surface is smooth and grey in color and more or less marked with concentric ridges. The lower surface is reddish-brown, and soft and velvety when young. The decay caused by this fungus begins in the sapwood and proceeds inward, so that the centre of the tree may remain sound for some time after the outer part has decayed. Some botanists regard this fungus as truly parasitic on living trees, others think it is saprophytic, attacking only weakened or dying trees and causing their decay.

(2) **Polyporus betulinus** This fungus may be classed with the preceding as a sapwood rot fungus. It occurs on the various species of birch. The sporophores are conspicuous, more or less white in color, convex above and somewhat hollowed below. The decay caused by this fungus is similar to that described for Fomes fomentarius. It is very common on birch, especially on trees that have been injured by fire or weakened in some other way.

A number of other fungi attack dead or dying trees and bring about their decay. Some of them are probably parasitic and attack living trees. Further study is necessary to determine whether they are truly parasitic or not. The following are among the most common in Eastern Canada.

Fomes applanatus, Polystictus versicolor, Polystictus pergamenus, Polyporus adustus, Polyporus cinnabarinus, Daedalia quercina, Daedalia unicolor, Polyporus pinicola.

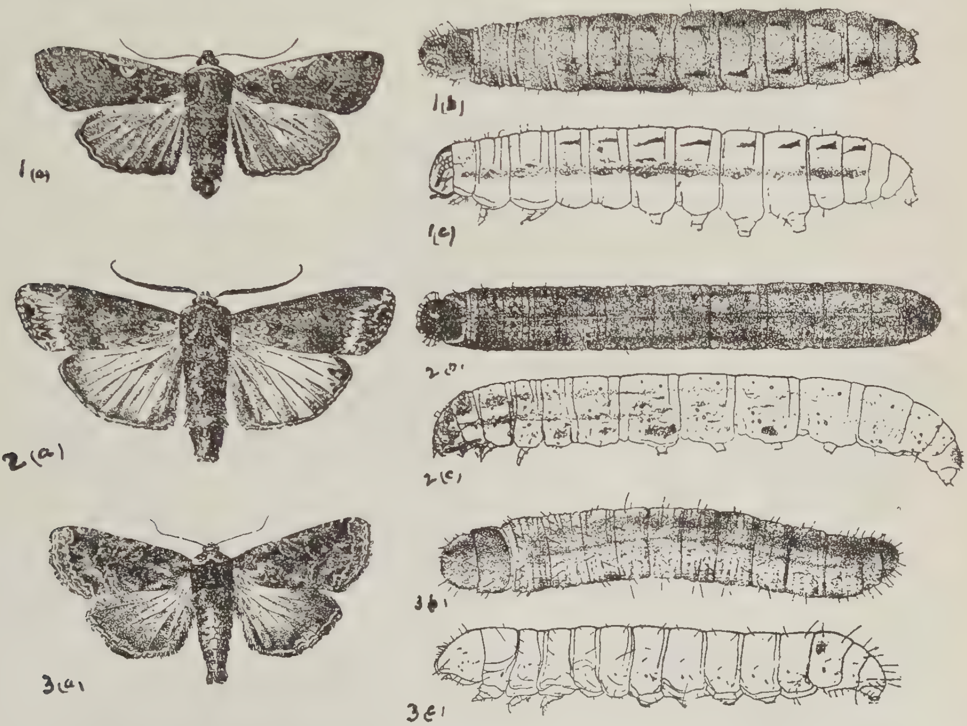
Methods of Control. As the spores of parasitic pore fungi find entrance at wounds care should be taken to avoid injuring trees. Wounds from pruning or from other causes should be covered with some protective substance. Paint is most commonly used, but is probably not effective unless renewed frequently. Other wound dressings used are tar and melted asphaltum. Those interested in this matter should consult Circular No 126, "Dressing for pruning Wounds on Trees" issued by the Ohio Agricultural College.

The protection of wounds may not be practicable in forest areas. Here the chief means of control will be the removal of diseased or dead trees or parts of trees. Many of these bear fruiting bodies of the fungi which produce each year vast numbers of spores. These spores are carried by the wind and thus the diseases are spread. The destruction of the dead and decaying diseased timber will also help to hold in check many insect enemies of trees.

CONCERNING CUTWORMS, WIREWORMS & WHITE GRUBS.

By W. Lochhead, Macdonald College.

These three kinds of insects do a vast amount of injury on the farms of Canada. Their work is known to farmers, but the insects themselves are not so well known since they work underground and are not readily observed. It is not generally recognized, for example, that there are many kinds of cutworms, wireworms and white grubs, differing to some extent in their habits and life history. It is the purpose of this article to give in a concise form some facts regarding these injurious forms which may help the observant farmer to deal with them whenever occasion arises.



Cutworms : 1 (a) Noctua c-nigrum (Spotted Cutworm) moth ; 1 (b) and 1 (1c) caterpillar or cutworm.
2 (a) Agrotis ypsilon (greasy cutworm) moth ; 2 (b) and 2 (c) cutworm.
3 (a) Hadena devastatrix (glassy cutworm) moth ; 3 (b) and 3 (c) larva.

CUTWORMS.

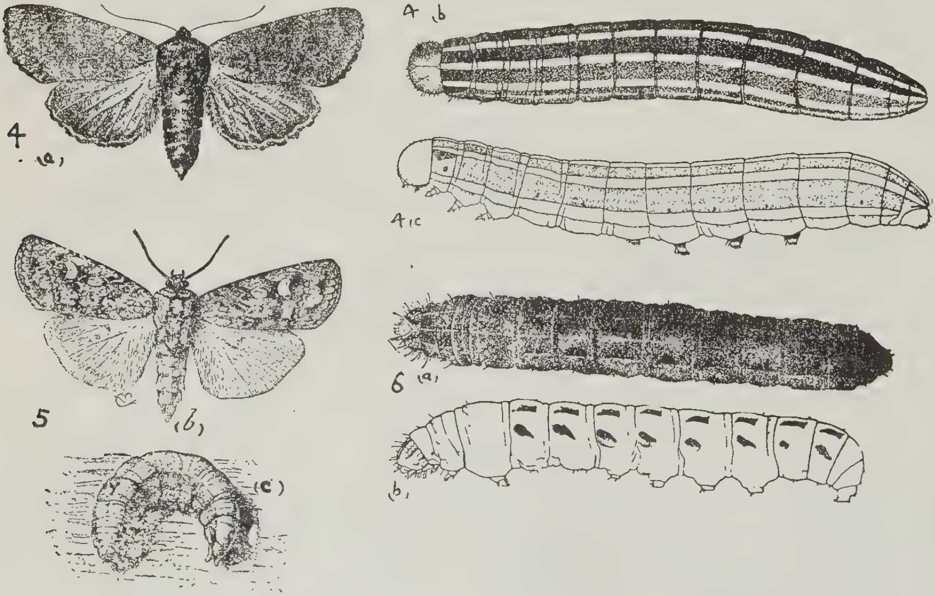
Cutworms are the caterpillars of the "miller" moths, which everybody has seen in summer evenings as they often fly through open windows into houses, attracted by lights. They are mostly plump-bodied, cylindrical caterpillars, dirty-grayish or whitish, and variously spotted and striped. They are night-feeders and are essentially grass and clover insects, and by far the greater part of them are bred in pastures and meadows. They are many species, some of which, however, feed on seedling cultivated plants such as corn, mangels, turnips, cabbages, tomatoes, etc.

Life History—The majority of the species hibernate as partly grown caterpillars, and pupate in the ground in late June or early July. The moths emerge in early August and lay their eggs in grass lands. The caterpillars that hatch from these eggs feed on the roots of grasses until winter sets in.

Habits—Cutworms get their name from their habit of cutting off young plants a little above the surface of the ground. They lie hidden in the day time in the ground close to the plants attacked, but at night they come to the surface to feed.

A few species assume a climbing habit, ascending fruit trees to feed upon buds and fruit. When food becomes scarce, and the numbers are great, some species migrate from field to field in armies, devouring every green thing on their march.

The commonly occurring cutworms are most injurious in spring, feeding ravenously upon young plants after their long winter's sleep in the ground. Some species appear in April, while others do not appear until May or June, or even July. Those appearing early go into pupation early and cease feeding.



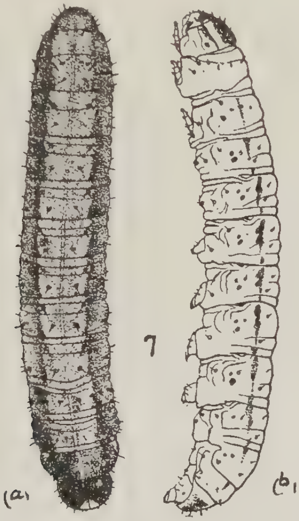
Cutworms : 4 (a) Nephelodes minians (Bronzed Cutworm) moth ; 4 (b) and 4 (c) larva or cutworm.
5 (b) Euxoa messoria (Dark-sided Cutworm) moth ; 5 (c) cutworm or larva.
6 Noctua clandestina (the W-marked Cutworm) larva.

KINDS OF CUTWORMS.

(1) **Spotted Cutworm** (Noctua c-nigrum) with two rows of triangular black spots on the back; pale brown or gray; 1 1-2 inches long when full grown. Active in April and early May on garden vegetables. Two broods.

(2) **W-marked Cutworm** (Noctua clandestina) with four rows of dark spots like W marks on the back; the sides of the spots bordered with pale yellow. Active in April and May in gardens.

(3) **Red-backed Cutworm** (Euxoa ochrogaster) with a bordered stripe down the back; body gray or dull brown. Active in May and June on garden and field crops.



7 Feltia subgothica (Dingy Cutworm)

(4) **Greasy Cutworm** (Agrotis ypsilon) with a faint dull dirty yellow stripe along the back; body dark greasy gray in color and greenish yellow below. Active in May and early June on corn and garden vegetables.

(5) **Variegated Cutworm** (Peridromia saucia) with several conspicuous yellow spots on the back, color of body ranging from pale gray to a dull brown. Active in May and early June in gardens.

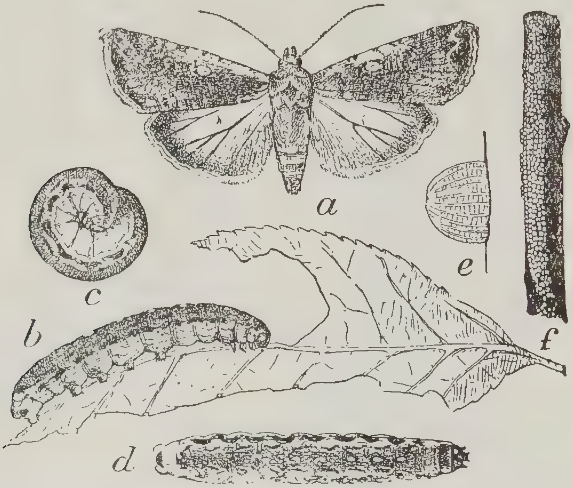
(6) **Dark-sided Cutworm** (Euxoa messoria) with a dark stripe on each side of the ashy-gray or pale greenish, or other light-colored tinged body. Active in May and June on fruits and garden vegetables.

(7) **Glassy Cutworm** (Hadena devastatrix), translucent whitish, tinged with bluish green, and without spots; head reddish-brown; neck-shield brownish. Active in May and early June on hay and garden vegetables.

(8) **Bronze Cutworm** (Nephelodes minians) with alternate stripes of olive bronze and yellowish--a pale stripe along the middle of the back, and two others on each side. Active in April and May in grass lands.

(9) **Yellow-headed Cutworm** (Hadena arctica), pale smoky gray with head and neck shield tawny yellow; without spots. Active into July on cereal crops and vegetables.

(10) **White Cutworm** (Carneades scandens), a yellowish-gray with whitish spots, spiracles black. A climbing cutworm feeding on buds; also feeds on vegetables.



Peridromia saucia (Variegated Cutworm); A. moth ; B. C. D. larva ; E. egg ; F. egg-mass.

(11) **Dingy Cutworm** (Feltia subgothica) with a wide buff gray stripe on the back; head and neck shield, and anal-shield dark brown. Feeds on garden crops, also sometimes a climber.

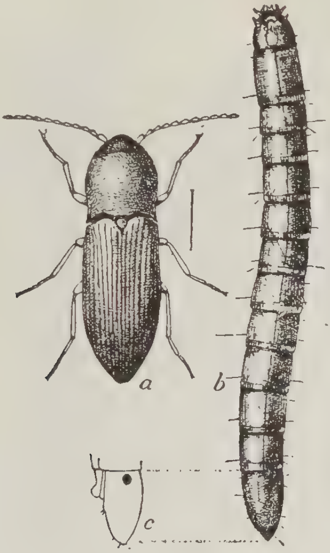
(21) **Spotted-legged Cutworm** (Psoragrotis vetusta) with black spots on legs. A climbing form feeding on peach buds.

(13) **Zebra Caterpillar** (Mamestra picta) with velvety-black back; with two golden yellow stripes on each side of the body, connected by narrow lines of the same color; head and feet reddish brown. Two broods. Feeds on leaves of cabbages and turnips.

(14) **Army-Worm** (Leucania unipuncta) with black and yellow lines along the back; body dark-colored; under surface greenish. Three broods.

CONTROL.

(a) The habit of coming to the surface to cut off the young plants leaves cutworms open to attack. Accordingly, a practical simple remedy has been devised for their control bythe use of poisoned baits. One of the best baits is the poisoned bran-mash made as follows:- Mix thoroughly 1-2 lb. of Paris Green with 50 lbs.,of bran to which a pint of molasses has been added; moisten with water but do not make it mushy; usually half a gallon of water is about sufficient. A handful of this poisoned bait should be scattered at the base of each cabbage and tomato plant, or where the area of infestation is large the bait may be scattered in handfuls along the rows. This process should be done at night-fall, just before the cutworms leave their hiding places. The bait is very tempting and is apparently more relished than the plants themselves for cutworms will be killed in large numbers. Usually one good application suffices to stop the depredations.



Agriotes mancus (Wheat Wireworm) ; A. adult beetle ; B. wireworm or larva : C. last segment of larva.

(b) Since the parent moths lay their eggs in August in weed and grass lands deep ploughing of such lands in autumn is of remedial value. Many eggs and young cutworms will be destroyed.

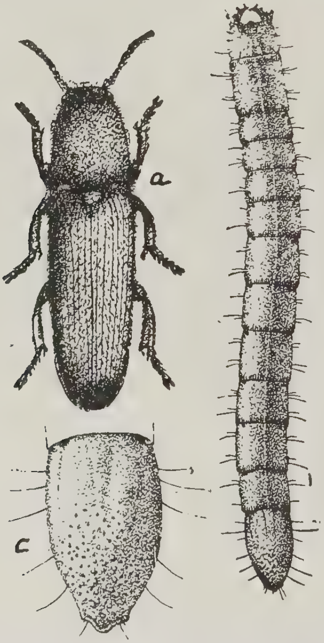
(c) Cabbages, tomatoes, cauliflower, etc. may be protected by fitting a collar of tin or paper around the stem, setting it two or three inches into the ground.

WIREWORMS.

Wireworms are the grubs or larvae of beetles known as click beetles or "skip-jacks" belonging to the family Elateridae. They are slender, cylindrical, yellowish or reddish brown wire-like grubs, ½ to 1 inch long, mostly vegetable feeders and living in the ground. Like the cutworms they are essentially grass insects and breed in pastures and meadows.

Several species are injurious to the roots of cereal crops, corn and potatoes.

Life History. In general the adult beetles emerge from their pupal cells in the ground in May, and lay their eggs in grass land on, or close to, the crown of the roots. The eggs hatch in a week or so and the grubs feed on tender roots. The development of the grub is slow for it does not mature until July or August of the following year when it changes to a pupa in an earthen cell. In another month the pupa transforms into a beetle, but it does not emerge until the following May. The life-history of most of the species is not thoroughly known but that given above is believed to be fairly accurate though there are exceptions.



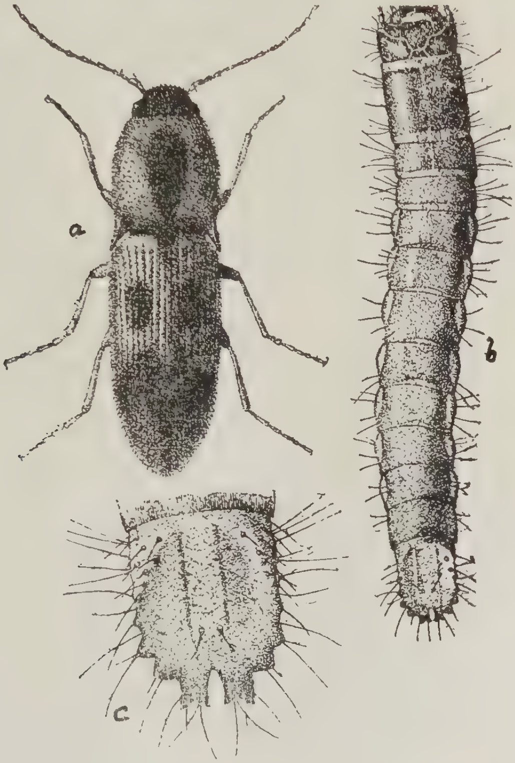
Melanotus cribulosus : The Corn Wireworm ; A. adult beetle ; B. wireworm or larva ; C. last segment of larva.

Kinds of Wireworms. The species most common and best known are the following:

(1) **Wheat Wireworm** (Agriotes mancus .), cylindrical, pale brownish yellow, with two black pits on the last segment which tapers gradually to a brown point. The pupa is pure white, and soft, and lasts about 3 weeks. The adult beetle is dark brown, with coarsely and densely punctate convex thorax; front or clypeus convex.

(2) **Corn Wireworm** (Melanotus communis), 1 to 1¼ inches long, light brown, smooth and shining, last segment ends in a blunt tubercle, common in corn lands. Pupa is white and tender and changes to a beetle in about a month. Beetle is slender, glossy, dark brown, with a more or less distinct median impressed line on basal half of thorax.

(3) **Elegant Wireworm** (Drasterius elegans), small, ⅓ to ½ inch long, light waxy yellow; last segment has an acute apical notch, nearly flat and roughish above. Beetle is dull reddish brown, sparsely pubescent; head black; a median black spot on the thorax; a black spot in front of the middle of each wing-cover, and a black cross-bar near the apex.



Drasterius elegans; A. adult beetle; B. wireworm or larva; C. last segment of larva.

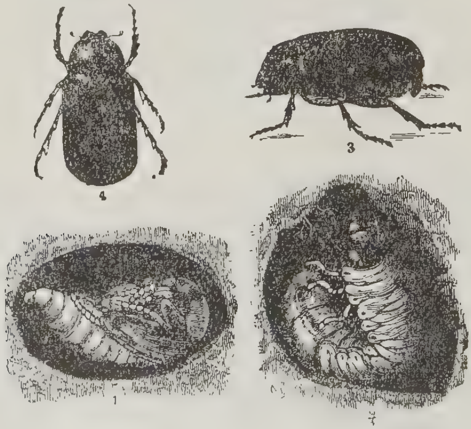
(4) **Discolored Wireworm** (Asaphes decoloratus), ¾ inch long; dark waxy yellow; terminal segment with an oval-shaped apical notch. This wireworm matures in May; pupal stage lasts about 3 weeks. Beetle is shining black with divergent hind angles on thorax; about 1-2 inch long.

(5) **Abbreviated Wireworm** (Cryptohypnus abbreviatus), dark, waxy yellow, and flattened; last segment with round apical notch. Beetle, 1-4 inch long, brownish black.

CONTROL.

No farm crop is immune from wireworm attack although many farmers claim that buckwheat, mustard, and rape are immune. Many attempts have been made to devise some reliable method of destroying wireworms. Some years ago Professors Comstock and Slingerland of the Cornell Agricultural Experimental Station and Professor Forbes of the Illinois Station conducted a very complete series of experiments extending over a number of years, and found that insecticides were practically of no value. They ascertained, however, that certain cultural operations were valuable in destroying large numbers of the transforming pupae and adults before they emerged from the cells in the ground. It was determined that these pupae and adults wintering in the pupal cells were very sensitive to disturbances such as late ploughing produces. Ploughing infested or suspected sod land twice—once in August with a good harrowing a week later, and again in late September or October—will break up many of the pupal cells and expose the beetles to conditions during the winter which they cannot survive.

This cultural process, however, will not interfere to any great extent with the immature wireworms, or those in the grub stage. When a sodland is broken there will naturally be wireworms in different stages of development, some in the first year larval stage, some in the second year, and others ready to pupate. Only those ready to pupate will in all likelihood be killed by the fall ploughing. In the following season however the young grubs are grown rapidly, and if the dying roots of the sod furnish sufficient plant food they will not do much feeding on the roots of the new crop, but they will be more injurious the year following. Now certain crops, such as, clover, barley, wheat and rye, are not so liable to attack as are corn, potatoes, mangels, oats; hence they are better adapted to follow sod. Clover can be sown with barley or rye and ploughed down after a cutting has been taken. This may be followed by corn or roots. Such a rotation will gradually exterminate the wireworms, and furnish crops that give a good yield.

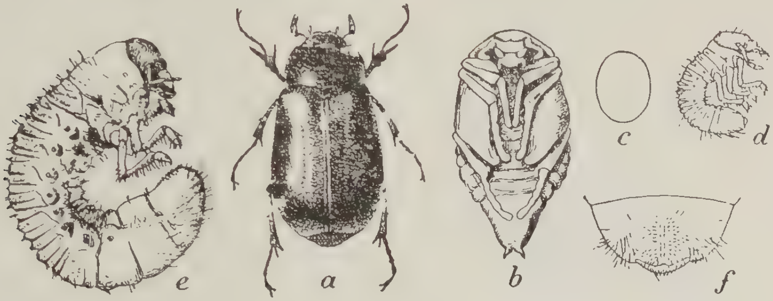


Lachnosterna fusca—with the grub and pupal stages.

Professor Forbes of Illinois proposes this rotation: plough the grass in early fall, and sow clover either with oats, wheat or rye. Allow the clover to stand two years and follow with corn or roots.

WHITE GRUBS.

White grubs are the larvae of June Beetles, also called May Beetles, belonging to the family Scarabaeidae. The large size, white body, brown head, enlarged hinder part of abdomen, and the curled-up attitude of the body distinguish them from other grubs that occur in the soil. They feed on the roots of all kinds of grasses, cereal crops, corn, potatoes, and root crops generally. They also injure strawberries, fruit trees, and shade trees.



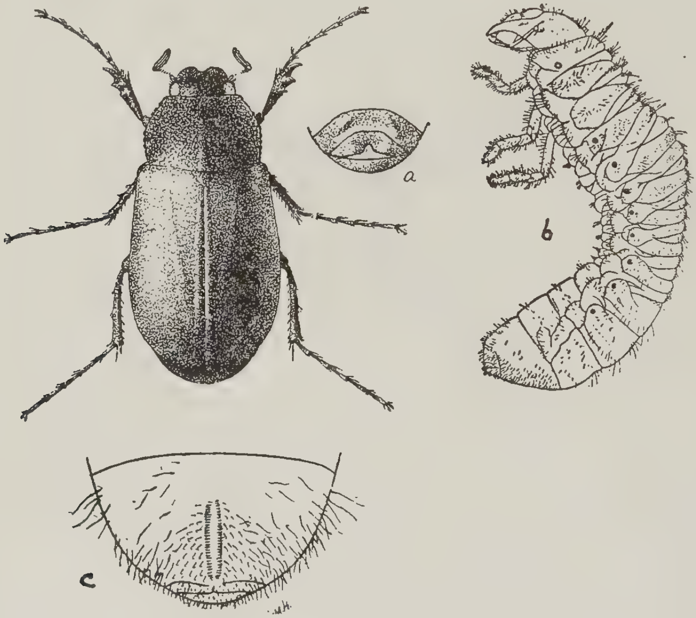
Lachnosterna arcuata : A. adult beetle ; B. pupa ; C. egg ; D. newly hatched larva ; E. nature larva ; F. last segment of larva.

The beetles feed on the leaves of various species of forest and orchard trees. There are several species, mostly belonging to the genus Lachnosterna.

Life History. The beetles emerge from their pupal cells in the ground in May and June, and deposit their eggs below the surface of the ground, usually on the roots of grasses. The grubs feed on the roots and often do considerable damage. They spend two full years as grubs, and in June or July of the third year of their life change to pupae. Two or three weeks later they change to adult beetles, but remain in the pupal stage until the following spring. In other words, grubs hatched in in June, 1910, change to pupae in July, 1912,and the beetles emerge in May and June, 1913. On the approach of winter the grubs descend into the ground for protection.

Habits. "The adult beetles emerging from the ground fly about at night in search of food, pair in the trees to which they resort in myriads, and retreat again to the earth by day, hiding themselves an inch or sometimes merely creeping under fallen grass or other similar shelter." The eggs are placed an inch or more beneath the surface and hatch in from ten to eighteen days. The males begin to die not long after pairing, and the females also perish after egg laying.

KINDS OF WHITE GRUBS. The species that exist in Quebec have not been thoroughly studied. Dr. Forbes of Illinois, however, has made a careful study of the forms existing in that state. He found the following species doing injury in corn fields: Lachnosterna fusca, L. gibbosa, L. inversa, L. rugosa, L. implicita, L. hirticula, L. ilicis, L. trista and L. fraterna. These species are difficult to distinguish, more especially in the larval stage. For indentification consult Blatchley's "Coleoptera of Indiana" and 17th Report of State Entomologist of Illinois, 1889-1890, by Dr. Forbes.



Lachnosterna rugosa ; A. June-bug, adult ; B. June-bug or white grub larva ; C. last segment of white grub and larva.

CONTROL.

As with Wireworms, remedial measures are difficult. Special rotations are advisable. Fletcher says "A short rotation in which clover follows grass or is grown at short intervals will prevent the increase of these insects. In this special rotation the small grains should follow clover before corn or potatoes." When a field becomes infested with White Grubs a portion of the clover field, for example, might be broken and planted to corn instead of planting corn after timothy or grass. To make up for the deficiency of clover that portion of the sod field which would have been devoted to corn could be sown with oats, vetches, etc., for green feed and hay. It is perfectly safe to put mangels, turnips and rape after old sod, although one will have to be on guard against cutworms nipping off the young plants.

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FIRST ANNUAL REPORT

OF THE

Quebec Society for the Protection of Plants from Insects and Fungous Diseases

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1908-1909

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SECOND ANNUAL REPORT

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